February
1945

Railway Mechanical Engineer

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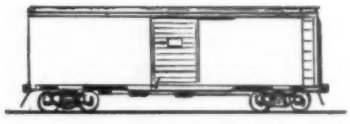
WINE
CAST STEEL

62 railroads
ARE NOW USERS OF
HOPPER FRAMES
THE WINE RAILWAY APPLIANCE CO.

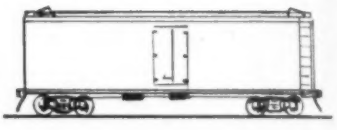
UNIT TRUCK

Has Established its Economy
In all Types of Freight Equipment
NOW IN SERVICE

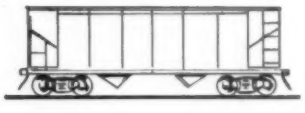
13783
BOX CARS



507
REFRIGERATOR

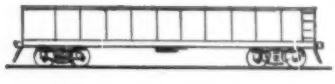


7761
HOPPERS

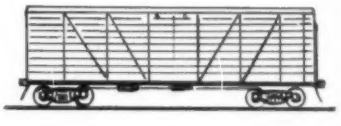


265
PULP WOOD

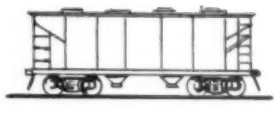
2450
GONDOLAS



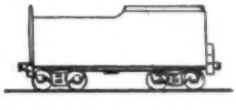
200
STOCK CARS



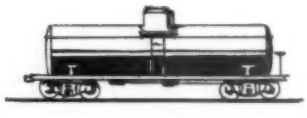
1115 COVERED
HOPPERS



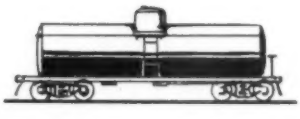
8 LOCO
TENDERS



1042
TANK CARS



3 AUXILIARY
WATER CARS



733
FLAT CARS

27867
TOTAL

UNIT TRUCK CORPORATION

140 CEDAR STREET — NEW YORK 6, N. Y.

Published monthly by Simmons-Boardman Publishing Corporation, 1309 Noble Street, Philadelphia, Pa. Entered as second-class matter, April 3, 1933, at the Post Office at Philadelphia, Pa., under the act of March 3, 1879. Subscription price, $3.00 for one year, U. S. and Canada. Single copies, 35 cents. Vol. 119, No. 2.

OAKITE "ON TIME" CLEANING

Provides Safe, Easy Way to CLEAN Headliners, Walls, Vestibules of Coaches

Use one part of Oakite Renovator in 2 to 3 parts water. Moisten a cloth in this solution. Apply to surfaces, then wipe dry. Soil and baggage marks or "stains" are quickly, safely removed without harm to paint. More and more roads are finding that Oakite Renovator is today's best answer for interior coach cleaning because of the highly satisfactory results it provides, the glossy finish it leaves . . . and its economy.

On this or on other maintenance work such as exterior washing of locomotives, cabs, tenders, coaches, Oakite "on time" cleaning helps you keep equipment in spick and span condition . . . does it at low cost. One of our Oakite Railway Service Representatives is near you. Ask him to make tests. Or write us direct. Your inquiry will be promptly answered.

OAKITE PRODUCTS, INC., WRIGLEY BUILDING, CHICAGO 11, ILL.

In Canada: OAKITE PRODUCTS OF CANADA, LTD.

TORONTO: 65 Front St. East—MONTREAL: 1 Van Horne Ave.

OAKITE RAILWAY SERVICE DIVISION

LOOK! A STEAM

L O C O M

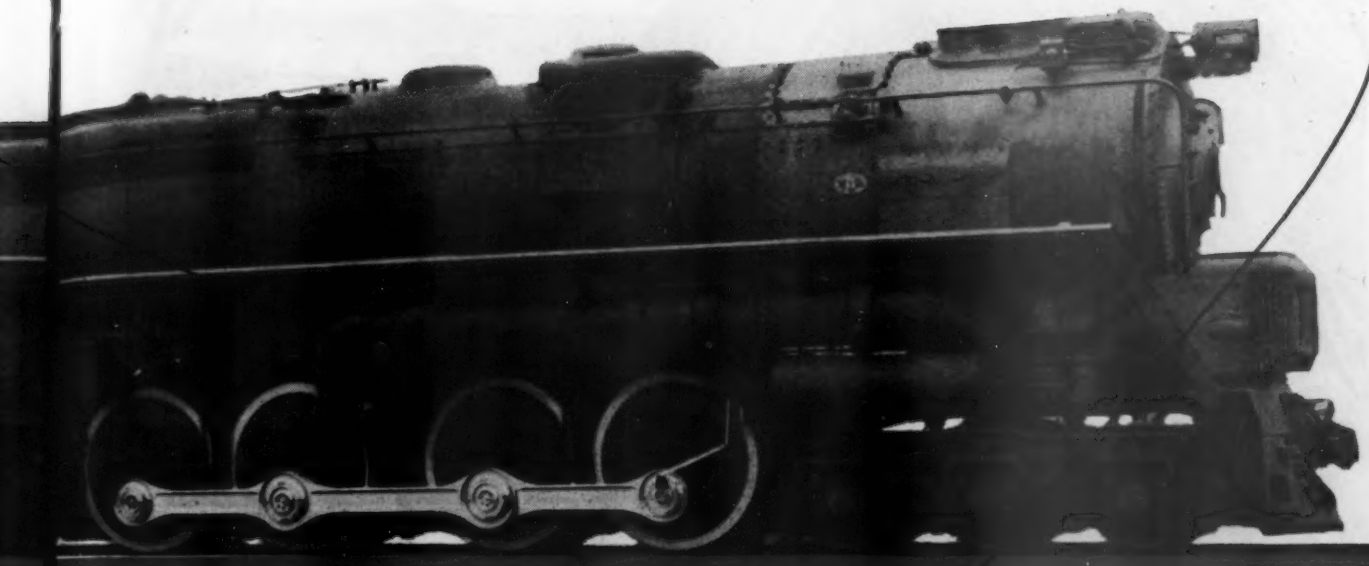
First of its type is this 6500-hp. Baldwin-Westinghouse, non-condensing, geared steam turbine locomotive built for the Pennsylvania Railroad in collaboration with the railroad's engineering staff.

It represents a forward step in steam locomotive construction, opening the way to higher speeds and greater operating efficiency for this class of power.

This new locomotive type combines Baldwin's locomotive building skill with Westinghouse experience in the manufacture of steam turbines of all kinds.

BALDWIN LOVES THE

TURBINE



O T I V E . . .

THE

BALDWIN

LOCOMOTIVE WORKS, PHILADELPHIA

BLW THE BALDWIN GROUP

Westinghouse

ELECTRIC & MANUFACTURING CO., EAST PITTSBURGH, PA.

Gaining Ground

GENERAL MACHINERY CORPORATION

GENERAL MACHINERY CORPORATION

HAMILTON, OHIO

THE NILES TOOL WORKS COMPANY • THE HOOVEN, OWENS, RENTSCHLER CO. • GENERAL MACHINERY ORDNANCE CORPORATION

Use "M-F" LOCK NUTS on *freight car trucks*

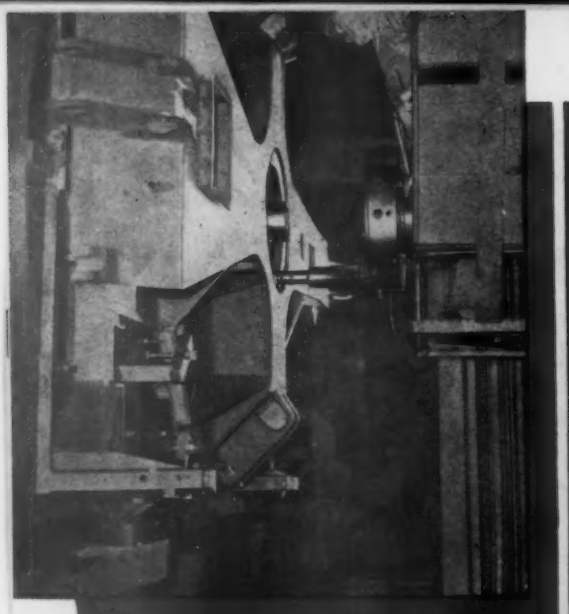
There is one prime reason . . . the loss due to a loose or missing common nut may amount to many times the cost of "M-F" Lock Nuts. They save money . . . they save property . . . they save labor.

Some of the uses of "M-F" Lock Nuts on freight car trucks are illustrated.

Our service men will prescribe the "M-F" Lock Nut for each location.

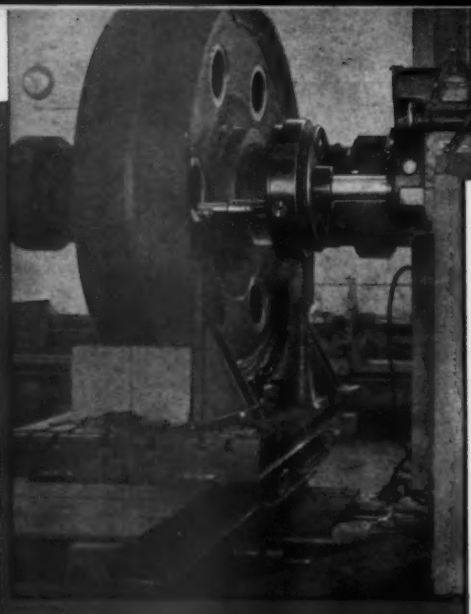
MAC LEAN-FOGG LOCK NUT COMPANY

2649 N. Kildare Avenue, Chicago 39, Illinois • ***In Canada: The Holden Co., Ltd., Montreal***



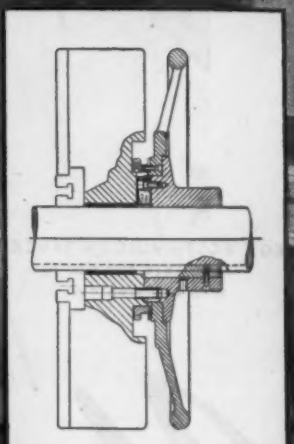
1 Awkward Facing Operation Performed Easily...

This large awkward armature weldment can be readily machined on a floor-type G. & L. A vertical rotary table positions the work for various boring, milling and facing operations. A Continuous Feed Facing Head is used for the facing operation shown.



2 Unusual Repair Job Simplified...

G. & L. with a Continuous Feed Facing Head is used to repair this huge herringbone gear. It is an unusual job. The machine spindle must be extended to clear the hub of the gear. Sufficient rigidity is built into the machine and its spindle to handle such jobs as these.



Sketch of Continuous Feed Facing Head and hand wheel which engages and disengages the slide feeds.

6 EXAMPLES

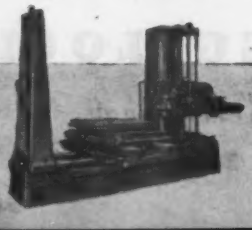
showing how G&L handles unusual jobs

Versatility of Horizontal Boring Machine with Continuous Feed Facing Head Simplifies Boring, Turning and Facing Operations on Irregular Shaped Work . . .

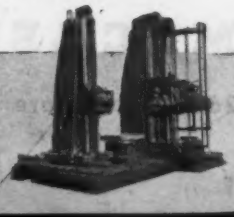
Those individual or unusual jobs whose size and shape make them unwieldy to handle can be profitably machined on a G. & L. Horizontal equipped with a Continuous Feed Facing Head. These six jobs were selected at random to show the wide range of work which can be economically produced on standard machines. In studying these machining problems which others have solved with a G. & L., you may find a better and less expensive method for doing your own work.

GIDDINGS & LEWIS

150 DOTY STREET



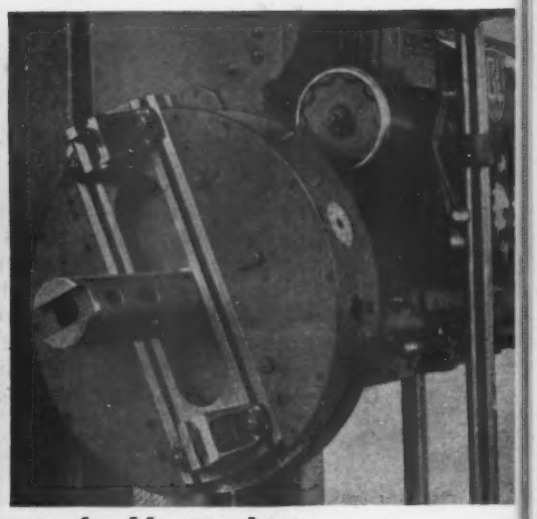
Right: G. & L. Table Type Machine.

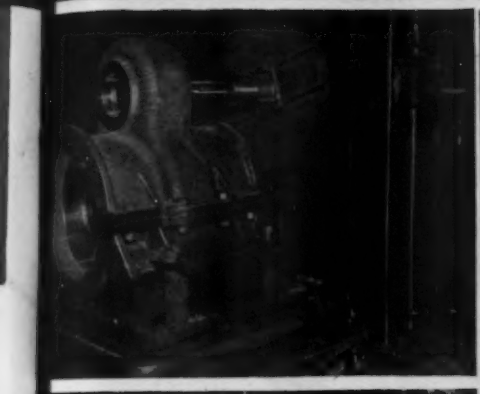


Right: G. & L. Floor Type Machine.

3 G. & L. Performs Turning Operation

This unusual casing job would be extremely difficult to handle on a vertical mill or lathe. Yet a G. & L. Horizontal Boring Machine with a Continuous Feed Facing Head and telescopic tool holder simplifies the turning and flange facing operations on this trunnion. Finish limits of .0005" were maintained. Ordinarily this type work would be rotated to turn the trunnion, but using a horizontal machine the work remains stationary and the cutting tool turns.



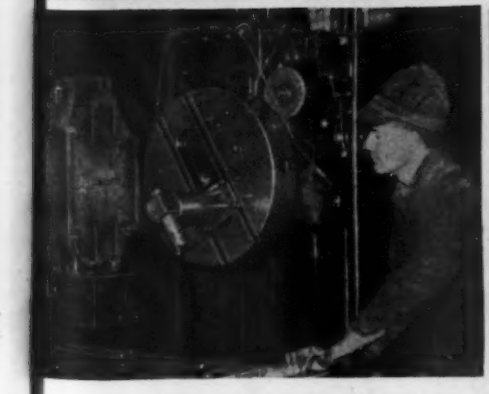


4 Horizontal Maintains Close Limits

Small work as well as large can be handled quickly and easily on the G. & L. Horizontal. Here is a housing being machined to "tenths." Work is mounted on a precision rotary table and indexed 180° to machine each end. The Continuous Feed Facing Head is adjusted to correct hole size and saddle feed is engaged for boring.

5 Attachment Makes Intricate Operations Possible

Numerous internal as well as external boring, facing and counterboring operations on this intricate valve body are easier to do on a G. & L. using a Continuous Feed Facing Head. The design and construction of this attachment makes possible many operations not ordinarily performed on a Horizontal Boring Machine.



6 Continuous Feed Facing Head Cuts Machining Time

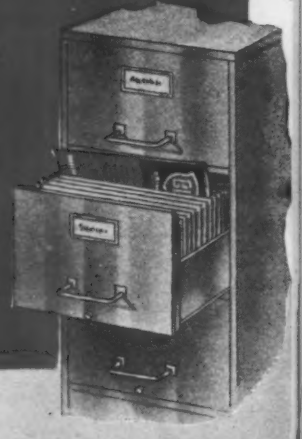
The G. & L. Continuous Feed Facing Head cuts machining time 50% on this job. Formerly the locomotive axle housing required 60 hours to bore—it now requires 30. A wide range of production and maintenance work can be performed in less time on the G. & L.

Profitable Machining Possibilities Open to You...

Do not overlook the profitable machining possibilities of your G. & L. Horizontal Boring, Drilling and Milling Machine, especially when it is equipped with the time-saving Continuous Feed Facing Head. Using this attachment it is possible to do many boring, turning, facing, recessing and threading operations which could not be done on other equipment. Giddings & Lewis engineers will show you how you can handle more jobs on your Horizontal Boring Machine. They will gladly help with your present and future machining problems and recommend the correct machine for your needs. There's no obligation for this engineering service.

Additional Data

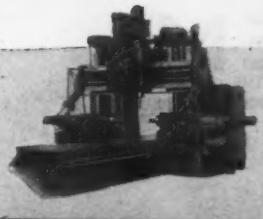
...covering the complete line of Giddings & Lewis machines and time-saving accessories is included in this catalog. Write for your free copy today—please indicate your business connection. Ask for Bulletin RM-25.



MACHINE TOOL CO.

FOND DU LAC, WIS.

Left: G. & L. Planer Type Machine.



Left: G. & L. Multiple Head Type Machine.

Keep your cutting equipment up—

DON'T LOWER YOUR "GUARD"—THIS IS A FIGHT TO THE FINISH!

When fighting the enemy, we use the best weapons that scientific skill can devise. The same is necessary when fighting for time here at home. From now until the end of the war, every bit of "tailoring" that can be done to manufacturing operations will mean extra guns, extra shells for your sons and ours now on the "line"!
As a saver of time and improver of quality in metal cutting, O K Tools deserve your careful consideration. Milling, reaming, turning, planing and boring can all be speeded up, and the quality usually improved, by the consistent use of these modern tools. There is a type and size for every metal cutting job in your railroad shop, whether it is the turning of great drive wheels or the milling of small fittings. And, remember—money spent for O K Metal Cutting Equipment now will pay dividends in your postwar program for years to come.

In O K Milling Cutters and Single-Point Tools, the bodies are drop-forged alloy steel of extreme strength; the blades or bits are separate cutting units of tool steel, high speed steel, carbide tipped, etc., held in mating serrations or other secure locking devices. These cutting edges are easily adjustable in line of wear and easy to renew or change.

O K blades and bits are available in hundreds of shapes from our standard stock, and special ones can be ground for special jobs. There is a fine "flexibility" about the O K System that, once tried, makes a strong and lasting appeal to practical engineers and experienced shop superintendents. If you have a metal-cutting problem, write us.

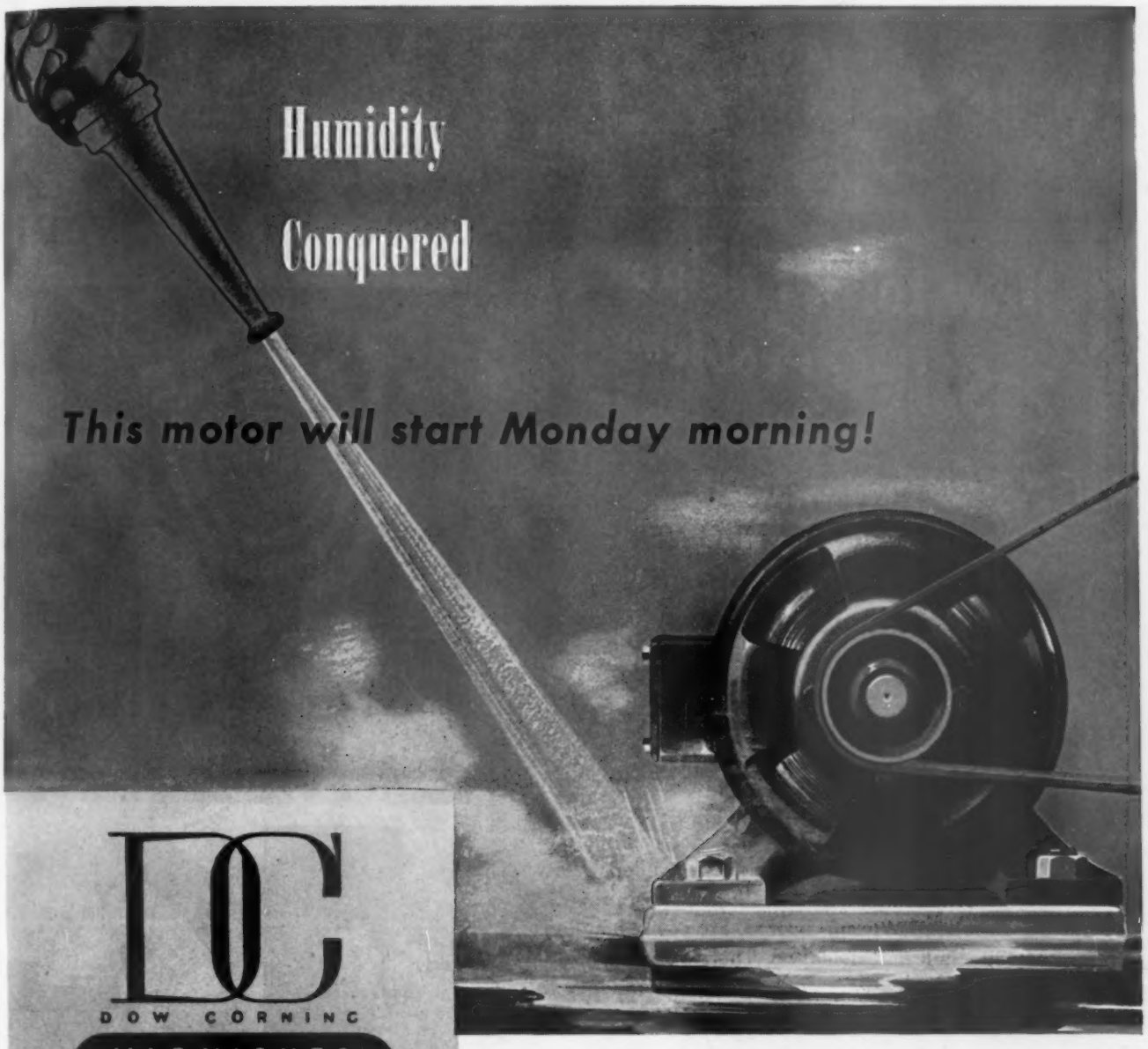
FREE BOOKLET ON GRINDING MILLING CUTTERS

Contains very useful data on grinding, adjusting, rebloding, clearances, etc. Profusely illustrated, clearly worded. Convenient file and pocket size. Glad to send it without charge to any interested shop man.

"O K" FOR EVERY METAL CUTTING JOB

THE O K TOOL CO., SHELTON, CONN.
Originators of the inserted-blade principle

THE TRADE O K MARK SYSTEM
OF INSERTED-BLADE METAL CUTTING TOOLS



DOW CORNING
VARNISHES

HIGH TEMPERATURE SILICONE INSULATION

Humidity, the primary reason for failure of motors and other electrical equipment, is conquered by DC Silicone Varnishes. Even under extreme conditions of condensation, severe overloads or idleness in moist locations, DC insulated equipment starts and runs at full load.

High temperature silicone insulation was first made possible by DC Varnishes. These new heat stable resins are natural complements to the inorganic spacing materials—mica, Fiberglas and asbestos. Dow Corning Silicone Varnishes provide bonding and filling dielectrics which are highly resistant to heat, moisture, oil and chemicals.

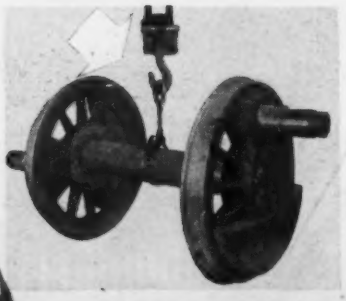
DOW CORNING CORPORATION
BOX 592, MIDLAND, MICHIGAN

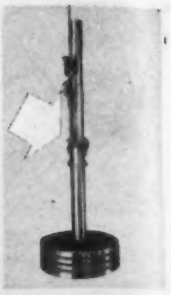
DOW CORNING 993 . . . available in commercial quantities, is a heat curing, high temperature stable silicone varnish for impregnating motor stators, transformer coils and other electrical equipment; for varnishing Fiberglas or asbestos served wire; for varnishing Fiberglas and asbestos electrical insulating cloths, tapes, tying cords and sleeving; for bonding Fiberglas and mica combinations.

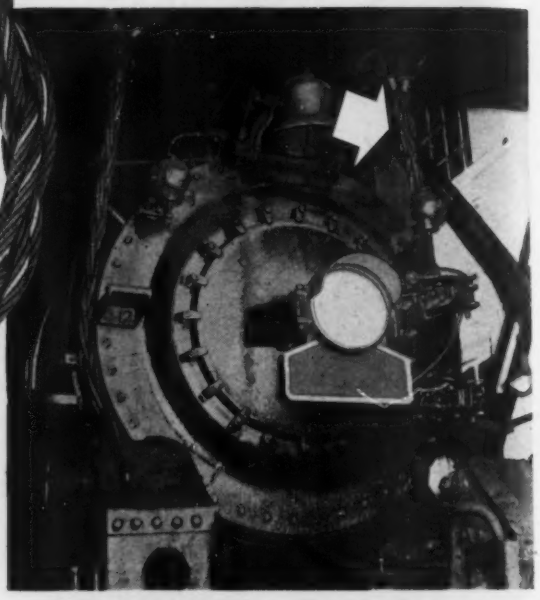
Dow Corning

How to Get Help on 2 SLING Problems

- Save TIME
- Save MANPOWER on both shop and derrick lifts







Picking up a piston rod in the shop and righting a heavy locomotive with a wrecking derrick are two extremes in lifts. Yet both jobs—and scores of others—can be speeded with Yellow Strand Braided Safety Slings.* For these adaptable wire rope slings, properly fitted for the kind of hitch desired, are easily handled, quickly attached and detached. Their patented braiding increases flexibility . . . cuts down the tendency to kink . . . promotes security for men and loads.

Since Yellow Strand Braided Slings weigh much less than the traditional type, fewer men are needed to work with them. Annealing and normalizing operations are also saved. Leading railroads are using braided slings to lift steam, Diesel and electric locomotives, super-heaters, truck assemblies, wheels, rims, journal boxes and rods; to move obstructions, to handle derailed cars by the drawbar, to pull in and hoist damaged units. Durable Yellow Strand Braided Slings will help you return equipment to service faster. Write now for information.

Riggers' Hand Book—Shows sling types, fittings, capacities. Send for FREE copy.

Broderick & Bascom Rope Co., Saint Louis

Branches: New York, Chicago, Houston, Portland, Seattle
Factories: St. Louis, Seattle, Peoria

*Patents:
U. S., 1475859, 1524671, 2142641, 2142642, 2299568;
Canadian, 252874, 158068

ARMY E NAVY

BRODERICK & BASCOM

YELLOW STRAND

Braided Wire Rope SAFETY SLINGS

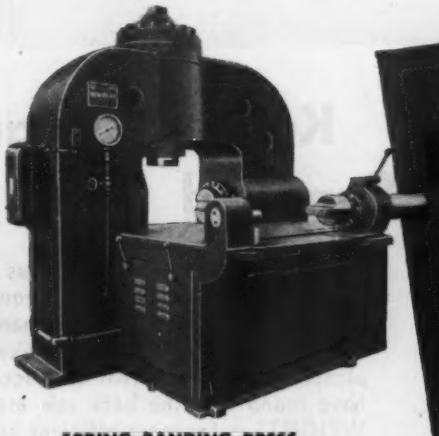
SPEED UP ASSEMBLY AND MAINTENANCE with W-S Hydraulic Shop Equipment

For fast, accurate assembly and maintenance jobs in railroad roundhouses and shops, Watson-Stillman hydraulic equipment answers today's demands, helps maintain uninterrupted traffic movement.

The power units and circuit designs built into W-S railroad equipment provide smooth, shockless press operation and pulsationless pressure application in forcing, driving, bushing, straightening, bending and lifting applications. Simplicity of their design and ruggedness of construction assures long, trouble-free service.

Portable and power-driven rail benders, bushing presses, wheel presses, crankpin and forcing presses, jacks, pit jacks and pulling jacks, spring shop equipment and Walter Stock adjusting machines are among the range of equipment available. These machines have been developed and perfected from a background of engineering and hydraulic experience acquired in serving railroad requirements for over 60 years. ***The Watson-Stillman Company, Roselle, New Jersey.***

PIT JACKS
With telescopic and plain rams; air - driven or double - plunger hand pumps.



SPRING BANDING PRESS
Vertical moving-down ram and horizontal clamping ram; assembly table and auxiliary ram.

WHEEL PRESSES
Straight or Inclined. Completely hydraulic, full hydro-pneumatic, plain hydraulic, or hand powered.

BUSHING PRESSES
With plain or U-slotted pedestal type beds.

WALTER STOCK ADJUSTING MACHINE
For lengthening, straightening or shortening locomotive parts. Equipped with motor-driven pump.

SPRING STRIPPING MACHINE
100-ton capacity; self-contained oil pump and control.

POWER-DRIVEN RAIL BENDERS
100-ton capacity.

SPRING FORMING PRESS
Available for either hydraulic or pneumatic power.

CRANK PIN & FORCING PRESSES
With hand pumps, rack and pinion pullback; with air or motor-driven pump and hydraulic pullback.

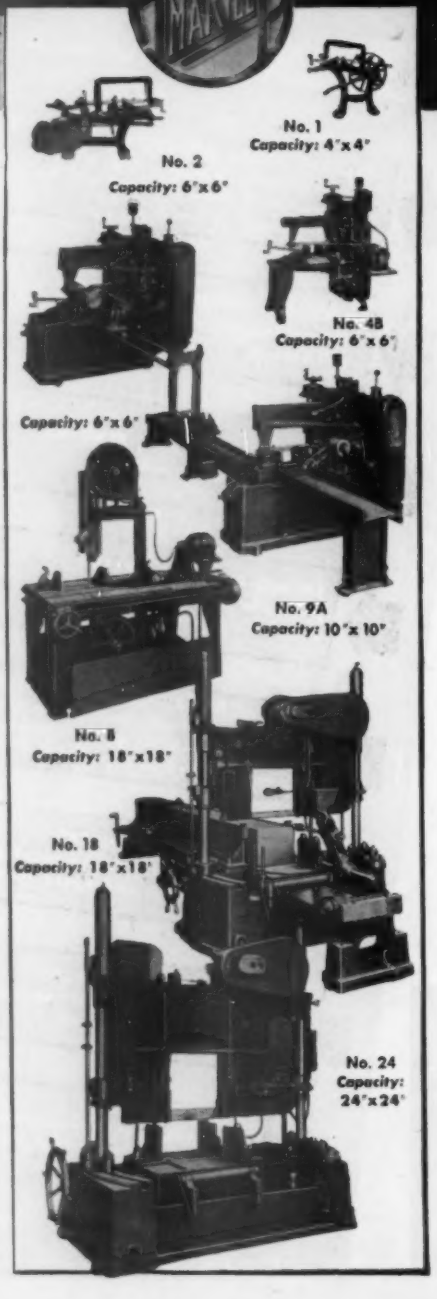
PORTABLE RAIL BENDERS
Hook or hinged — Yoke types; for flat, "T", girder and guard rails.

SPRING TESTING MACHINE
50-ton capacity, weight springs up to full working load.

PULLING JACKS
Adjustable, three-leg mounting; self-contained cylinder and pump.

WATSON-STILLMAN

Designers and manufacturers of hydraulic equipment, forged steel fittings and valves



Keep 7 Steam Hammers Supplied With Forging Steel

At the Cicero plant of the Atlas Forgings Company, two MARVEL No. 9 High Speed Hack Saws, equipped with heavy duty work handling equipment keep 7 steam hammers supplied with forging steel. The Atlas Forging Company (like most of the other leading forge plants of the country that have accepted MARVEL Saws as standard), have found that the hack saw method of cutting steel TO EXACT WEIGHTS is far more efficient and economical than with any other method formerly used by the industry.

With these two MARVEL High Speed Saws one operator can keep 7 hammers supplied with EXACT SIZE steel and still have time for other work. The initial investment is small—and the cost per cut is unbelievably low. Contrast this with the old method of cutting-off, not requiring an extra heat, frequently with a resultant greater loss of steel.

The MARVEL Saws shown above have found special favor with the forging industry and Machine Shops where heavy demands are put on hack sawing machines. This MARVEL Saw, with its rugged work handling equipment, will stand up under the heaviest punishment and for continuous 24 hour operation.

Write for Bulletins

ARMSTRONG-BLUM MFG. CO.

"The Hack Saw People"

5700 W. Bloomingdale Ave. CHICAGO 39, U. S. A.

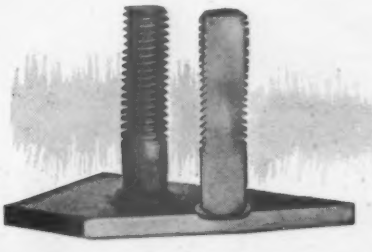
Eastern Sales Office: 225 Lafayette St., New York 12, N. Y.

MARVEL SAWS

End-weld studs in ½ second—automatically!

- ★ **Complete fusion results between stud and metal.**
- ★ **No drilling holes, or hand-welding bolts—saves time and material. Studs accurately located.**
- ★ **One operator can weld more than 1000 studs a shift. No previous welding experience is necessary.**
- ★ **Thousands of guns are now in use in more than 500 shipyards and industrial plants.**

The Nelson Stud Welder is simple to use. All welding is automatically controlled. The tool is completely portable, or may be operated from a fixed jig.



Cutaway view of a stud weld (after etching with Nital) shows the complete fusion of the stud to metal . . . the result of complete shielding of the arc, accurate arc timing, and the use of "flux-filled" studs.

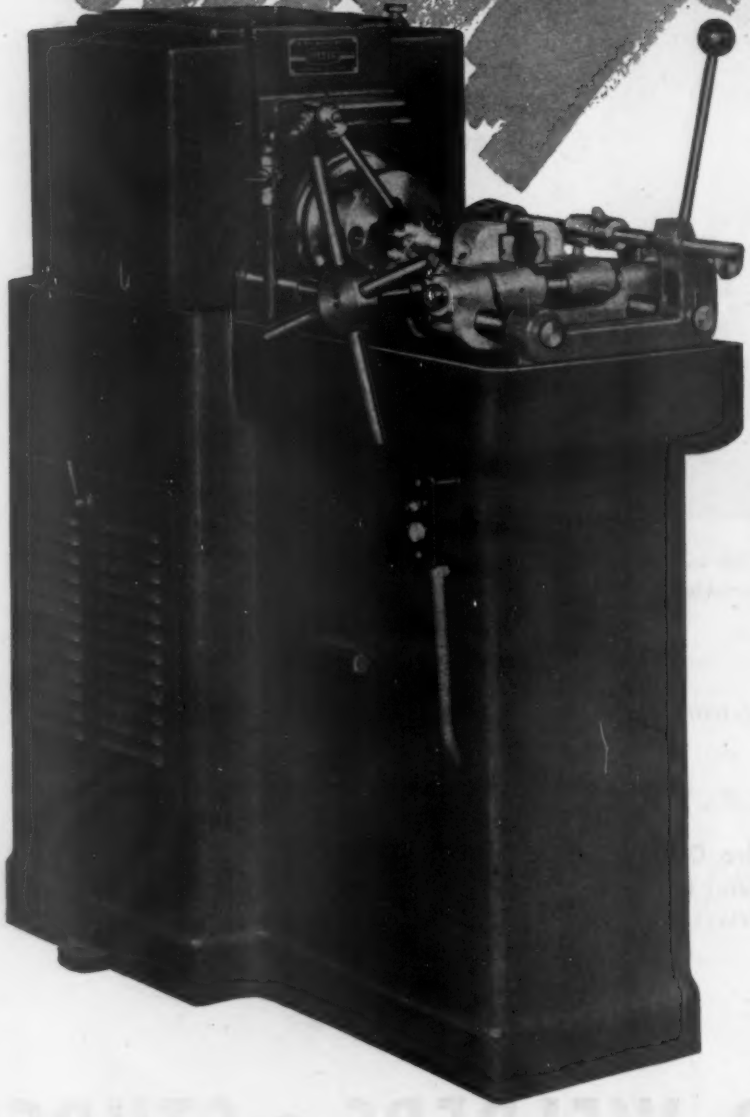
For complete details, prices and catalog, write:

NELSON SPECIALTY
WELDING EQUIPMENT CORPORATION

Dept. R, 440 Peralta Ave., San Leandro, Calif.
Eastern Representative: Camden Stud Welding Corp.
Dept. 22, 1416 South Sixth Street, Camden, N. J.

NELSON STUD WELDERS & STUDS

You Can Handle a WIDE VARIETY of Threading Jobs on this Versatile Machine



Oster No. 542 "RAPIDUCTION JUNIOR" is designed to handle a wide variety of standard and special threading jobs at high speed and with sustained accuracy.

The revolving die-head and open type vise facilitate handling stock in and out of the machine at maximum speed.

When "RAPIDUCTION JUNIOR" goes into action on production threading of bolts, rods, studs, pipe, and nipples, the moderate price of this machine is rapidly absorbed through lower unit costs.

Range of No. 542 "RAPIDUCTION JUNIOR"

Regular Bolt Range: $\frac{3}{16}$" to $1\frac{3}{4}$"

Regular Pipe or Nipple Range: $\frac{1}{8}$" to $1\frac{1}{4}$"

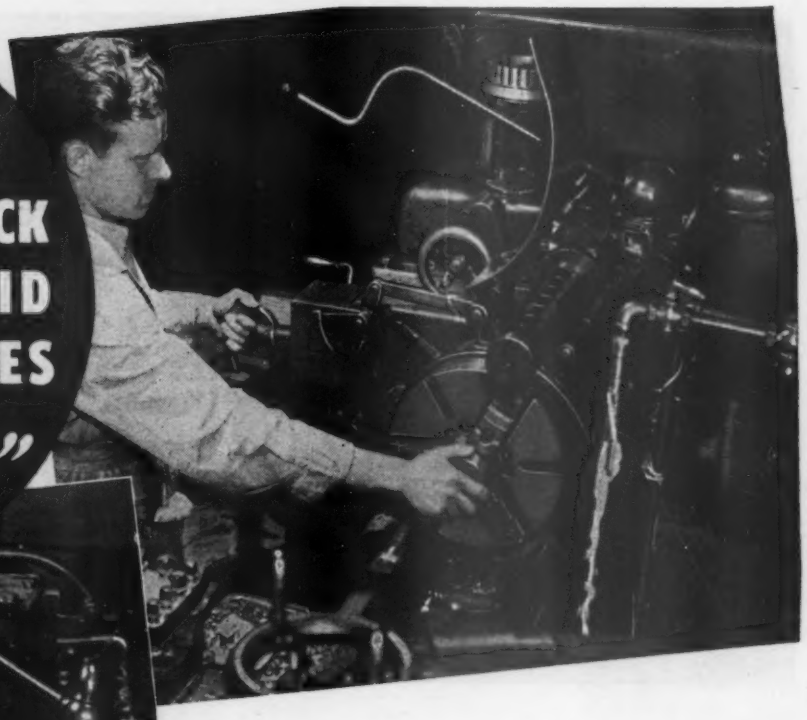
Note: When required, various types of vise inserts are furnished at extra cost for holding different kinds of work.

Complete specifications and production speeds of the No. 542 "RAPIDUCTION JUNIOR" are included in Catalog "LIST NO. 23". Write for a copy.

OSTER

THE OSTER MANUFACTURING COMPANY • 2030 EAST 61ST ST., CLEVELAND 3, OHIO, U. S. A.

"We figure OUR POWER CHUCK WRENCHES PAID FOR THEMSELVES in 60 days"



THE C. L. Gougler Machine Company, Kent, Ohio, is running all-out on war work. Their turret lathes are going 24 hours a day. On this basis, their time studies show that a Warner & Swasey Power Chuck Wrench installed on a turret lathe increases machine output to an extent which means that the Power Chuck Wrench has paid for itself in 60 days.

Comparisons have been made of two operators of equal ability, on exactly the same job, on the same model turret lathe, working side by side. But one of these machines is equipped with a power chuck wrench. The operator using the power chuck wrench will produce 30% more work and is fresh and fit at the end of his day. The other is pretty well fagged out. That's understandable because, as the turret lathe foreman points out, chucking and removing the piece takes more physical energy than is required in the actual machining of a dozen pieces.

Better Start Action About Getting Warner & Swasey Power Chuck Wrenches On Your Turret Lathes

You can make heavier, time-saving cuts on pieces that are power chucked. Grip pressures are controllable and uniform so power chucking is safe for light-walled, fragile pieces, too. Women operators can be used on chucking jobs formerly restricted to masculine strength because heaving on chuck wrench handles is eliminated. A turn of a knob is all that is necessary. Operator fatigue is a big factor in war production now—it will be a big factor in postwar competition. Easing the work means raising production. Better talk to your Warner & Swasey representative about Power Chuck Wrenches right now. Write Warner & Swasey, Cleveland, Ohio.

YOU CAN MACHINE IT BETTER, FASTER, FOR LESS . . . WITH A WARNER & SWASEY

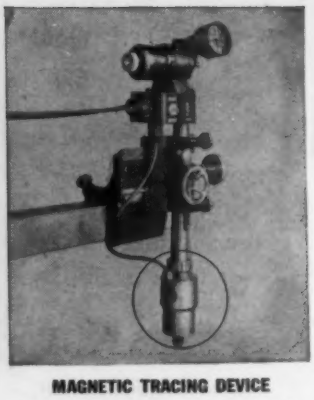
WARNER & SWASEY · CLEVELAND · OHIO

TURRET LATHES, SADDLE AND RAM TYPES — CHUCKING AND BAR TOOLS — TAPPING AND THREADING MACHINES

Illustration Courtesy of By-Products Steel Corp., div. of Lukens Steel Co., Coatesville, Pa.

CENTRALIZED GAS CONTROL UNIT

Gives the operator remote control of the pilot light, acetylene, preheating and cutting oxygen from his station at the tracing device.



MAGNETIC TRACING DEVICE

An exclusive Airco feature, this device guides cutting torches by automatically following the contour of a steel cam or template.

CUTTING METAL PARTS, CUTTING COSTS

with the

AIRCO No. 6A OXYGRAPH

The motor-driven Airco No. 6A Oxygraph is designed to provide the speed, flexibility and accuracy essential to lowest-cost production of flame-cut steel shapes in any quantity.

It quickly cuts steel plate of light and heavy sections to any shape and size. It can be used for beveling, squaring, straight cutting, stack cutting—changing from one job to another in minimum time—using up to eight torches with standard equipment.

The listing below of some of the plus factors of the No. 6A Oxygraph provides an inkling of its wide acceptance throughout the metal working industry as an important production tool:

1. Extreme accuracy under load—the pantograph design provides maximum resistance to torsion and deflection.
2. The rigid, sturdy base gives trouble-free support to the stout vertical posts and pantograph assembly.
3. Manual, magnetic or spindle type tracing devices can be used.
4. Ball-bearing mounted arms provide uniform, friction-free response to tracing device movement.
5. Centralized gas control unit for individual flame control saves operator's time.
6. Hose or cable lines can't snarl or pinch.

For further details write Department RME, New York Office for Catalog ADC-628—or ask your local Air Reduction office.

INDEX SPEED CONTROL

Permits easy, accurate adjustment of torch travel speed during cutting. Speed is visible on the Tachometer attached to the unit.

ADJUSTABLE TORCH HOLDER

Allows torch to be moved easily and locked tightly at any desired position along the bar or tilted up to 45° for bevel cutting.

AIR REDUCTION

General Offices: 60 East 42nd Street, New York 17, N. Y.
In Texas: Magnolia Airco Gas Products Co. • General Offices - Houston 1, Texas
Offices in All Principal Cities

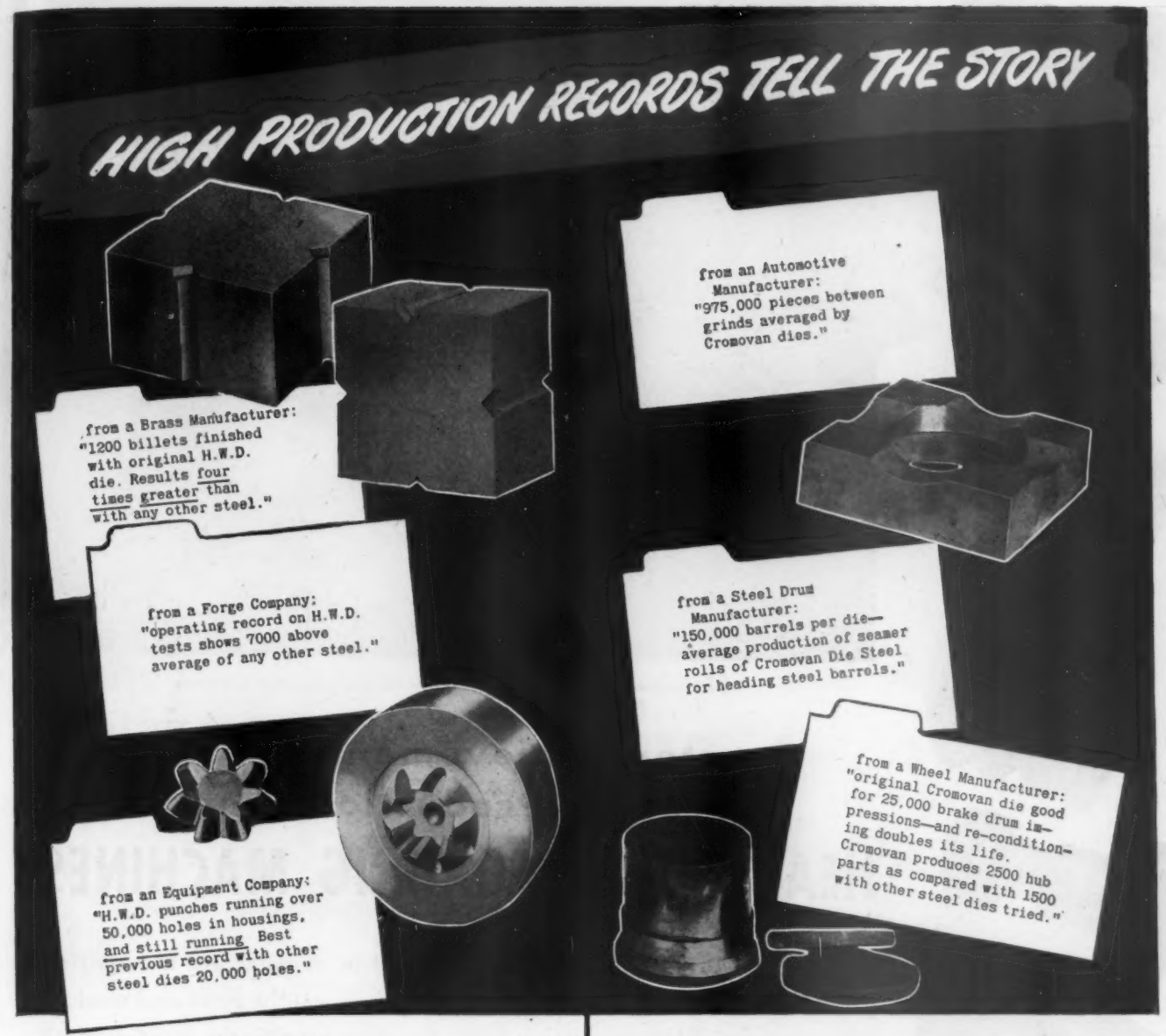
AIRCO

Gas Cutting Machines

A Type and Size for Every Cutting Need

IDEAL TOOLS FOR SPEED, FLEXIBILITY AND ACCURACY IN METAL SHAPING

HIGH PRODUCTION RECORDS TELL THE STORY


from a Brass Manufacturer: "1200 billets finished with original H.W.D. die. Results four times greater than with any other steel."
from a Forge Company: "operating record on H.W.D. tests shows 7000 above average of any other steel."
from an Equipment Company: "H.W.D. punches running over 50,000 holes in housings, and still running. Best previous record with other steel dies 20,000 holes."
from an Automotive Manufacturer: "975,000 pieces between grinds averaged by Cromovan dies."
from a Steel Drum Manufacturer: "150,000 barrels per die—average production of seamer rolls of Cromovan Die Steel for heading steel barrels."
from a Wheel Manufacturer: "original Cromovan die good for 25,000 brake drum impressions—and re-conditioning doubles its life. Cromovan produces 2500 hub parts as compared with 1500 with other steel dies tried."

H W D
DIE STEEL

For Hot Work

Performance sheets picked at random give assurance that Firth-Sterling quality die steels will meet your particular high output problem with record-making satisfaction. H.W.D. Hot Work Die Steel provides exceptional toughness, wearing quality and stability. It is recommended for general hot work operations involving severe pressure or impact, including forming, forging and die casting. For detailed operating information, write for H.W.D. Bulletin SL-2014.

The Firth-Sterling line includes six other hot-work die steels

CROMOVAN
DIE STEEL

For Cold Work

Where production in big figures is required, Cromovan is the preferred die steel. It is particularly adapted to cold work and offers the outstanding features of improved machinability, high abrasion resistance, unusual depth of hardness (preventing sinking), and minimum dimensional change during hardening. Used for cutting and forming dies, and for many special operations where conditions are unusual. Send for a Cromovan Bulletin SL-2022.

The Firth-Sterling line includes six other cold-work die steels

ARMY-NAVY E

Firth-Sterling
STEEL COMPANY

6" Ajax machine forging sockets in two ends of female member of Di-Lok Chain

Greater Achievements Require Greater Production From

HEAVY-DUTY FORGING MACHINES

★ Industrial Progress in almost every field of manufacture is requiring products of greater strength and toughness that can be produced to close tolerances on a high production basis. Forgings provide the great strength required, due to the grain flow being refined and shaped to the contour of the product in the forging die.

Uniformity, at a high degree of accuracy, is provided by AJAX Forging Machines due to their sound mechanical construction embodying many exclusive, patented features.

High speed production on AJAX machines is accomplished by the patented direct acting air clutch providing instantaneous response to the operation of the treadle.

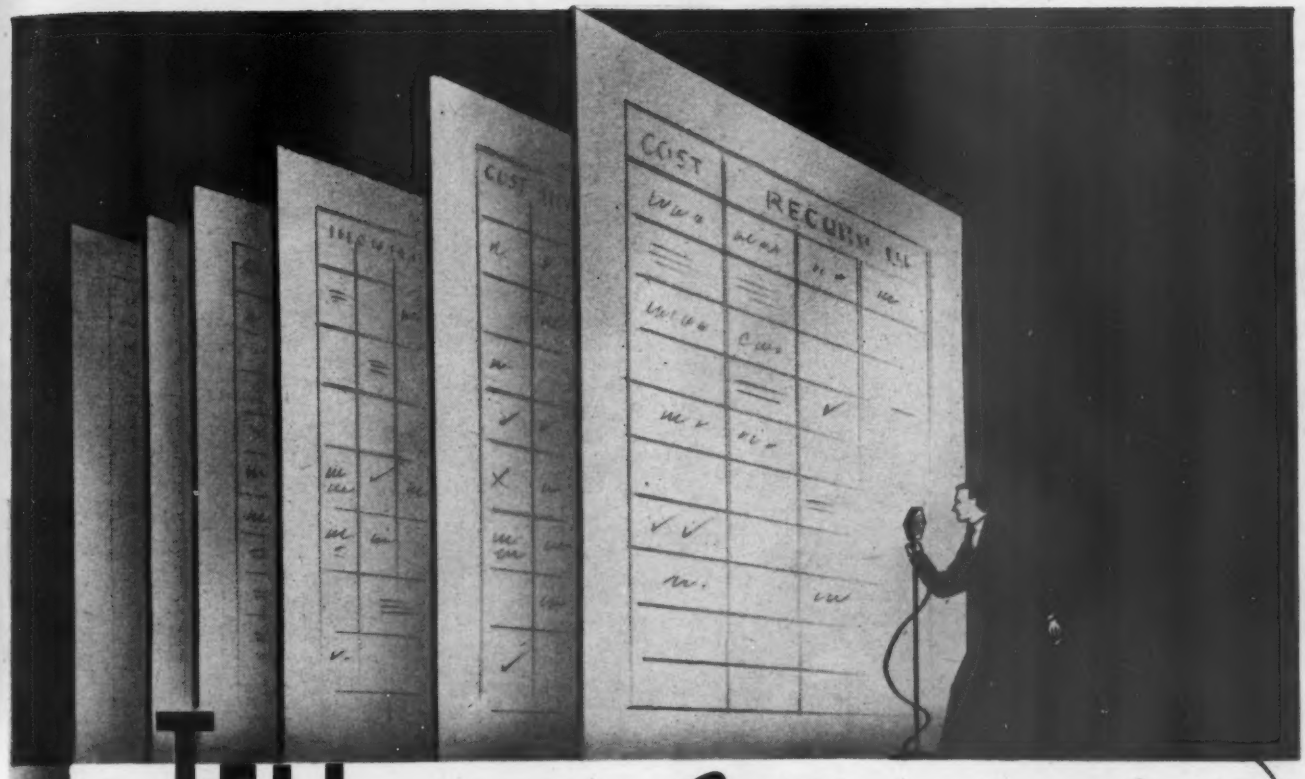
Forgings such as these illustrated are being produced on AJAX Forging Machines faster, better and at less cost for manufacturers of ships, airplanes, trucks, tractors, tanks, diesels, ordnance, locomotives, agricultural machinery and other products.

Write for Bulletin 65-B

THE AJAX MANUFACTURING COMPANY

EUCLID BRANCH P. O. CLEVELAND, OHIO

621 MARQUETTE BUILDING • CHICAGO, ILLINOIS



TELL *your Cost records* WHAT TO SAY....

Any good businessman pays strict attention to the facts his cost records tell him. But he doesn't let it go at that—he makes sure that his cost records *have the right kind of facts to deliver.*

When you use Clark Products you make sure that your own cost records will give a business-like report of painstaking engineering, of tough and enduring quality, of practical usefulness—stated in low cost performance and lasting satisfaction.

CLARK EQUIPMENT COMPANY • *Railway Division* • BATTLE CREEK, MICHIGAN

CLARK RAILWAY TRUCK . . . A PROMISE OF MORE COMFORTABLE TRANSPORTATION—SMOOTH, SWIFT, NOISELESS!

CLARK BLIND RIVETS . . . CUTTING ASSEMBLY TIME AND COSTS, REVOLUTIONIZING MANY PHASES OF PRODUCT DESIGN.

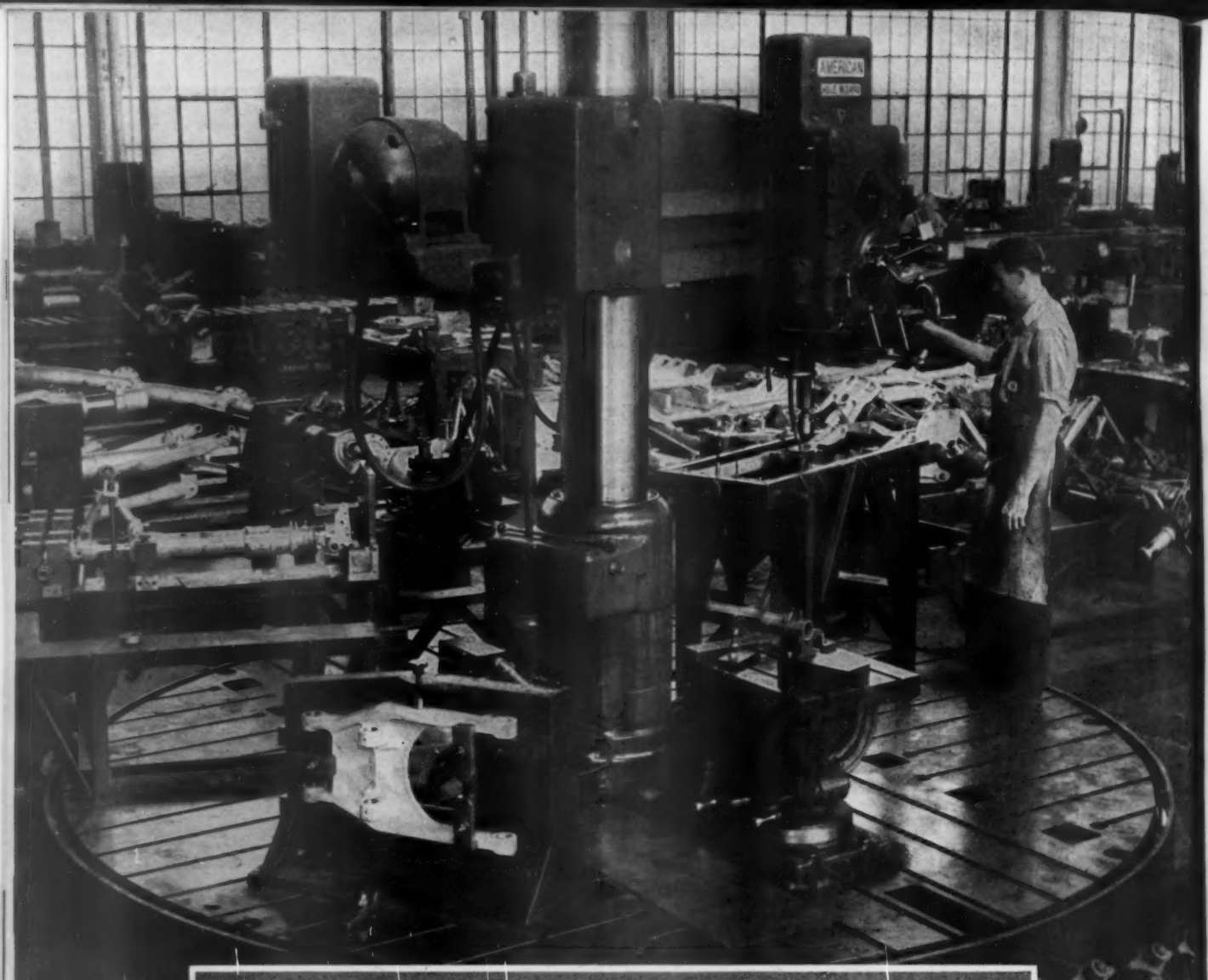
CLARK ELECTRIC STEEL CASTINGS . . . OF INTRICATE DESIGN AND VARIED SELECTIONS—OF UNIFORM FINE QUALITY.

CLARK GEARS AND FORGINGS . . . TRUSTED STAND-BY'S OF RAILROAD BUYERS—FOR ECONOMY AND SATISFACTION.

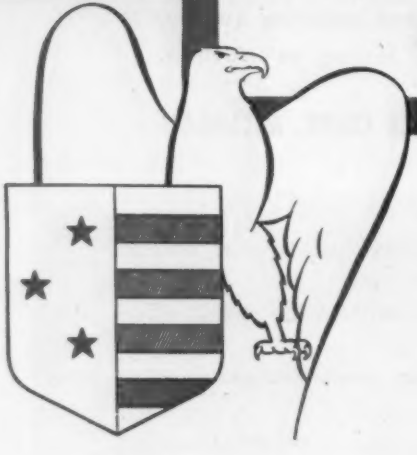
CLARK CELOR DRILLS AND REAMERS . . . VETERAN "RAILROADERS" WITH A RECORD OF TOUGH DEPENDABILITY.

CLARK INDUSTRIAL TRUCKS AND TRACTORS . . . FAST, VERSATILE "DISCOVERERS" OF HUGE SAVINGS.

OTHER PRODUCTS OF CLARK—Metal Spoke Wheels, Front and Rear Axles, Axle Housings, Transmissions, Trailer Axle, Booster Unit, Torque Converter.



IDLE MACHINE TIME
ELIMINATED



As the illustration shows, this "American" Hole Wizard Radial Drill is equipped with a circular base. This base permits multiple work set-ups for successive operations, thus completely eliminating idle machine time resulting from changing from one work set-up to another.

This is one plant's contribution to solving the man power shortage. By keeping its machines in constant operation, it reduces man power requirements to an absolute minimum.

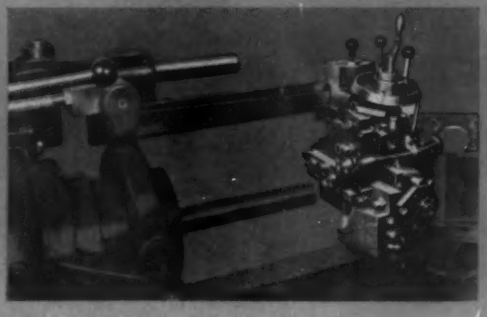
"American" Hole Wizard Radials are meeting the demands of such continuous service.

THE AMERICAN TOOL WORKS CO. CINCINNATI, U.S.A.

Lathes and Radial Drills

Taper bolts

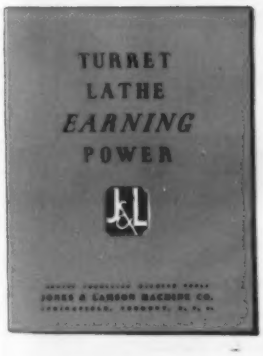
ON A PRODUCTION BASIS



If you are interested in turning taper bolts faster and more accurately, you will want to know more about the productive possibilities of this combination straight and taper roller turner and our method of machining taper bolts on a production basis.

The rolls and cutter of this roller turner can be adjusted rapidly to turn any diameter from $\frac{3}{4}$ inches to $2\frac{1}{2}$ inches. Conversion from turning straight diameters to turning tapers up to $\frac{1}{4}$ inch per foot can be made instantaneously at any point in the operating cycle.

Write to us for more detailed information and our book "Turret Lathe Earning Power" — your request will receive a prompt reply.



JONES & LAMSON
MACHINE COMPANY
Springfield, Vermont, U.S.A.

Manufacturer of: Universal Turret Lathes • Fay Automatic Lathes • Automatic Double-End Milling and Centering Machines • Automatic Thread Grinders • Optical Comparators • Automatic Opening Threading Dies and Chasers.

Cut lay-up time for cleaning • Solve your labor problems

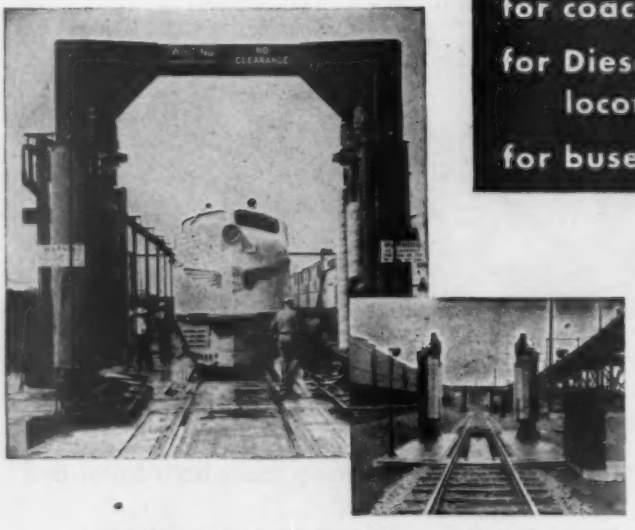
with

WHITING CAR WASHERS

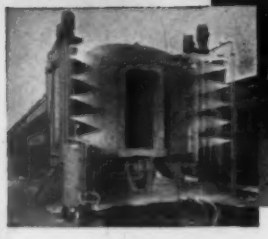
By eliminating slow, expensive hand washing methods, Whiting car washers reduce costs as much as 50%—and save 75% in time and labor.

Whiting washers assure thorough cleaning with self-aligning brushes that compensate for car tilt. All models safeguard car finish as well; installations use water alone, or, for extremely dirty cars, cleaning solution followed by a carefully timed water rinse.

Write for information on the washer which will solve your washing problems. Models are available for cleaning coaches, Diesel-electric locomotives, tenders, trackless trolleys, street cars, buses, and trucks.

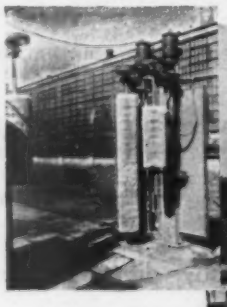


for coaches
for Diesel-electric locomotives
for buses



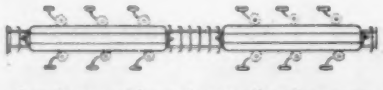
for coaches . . . Averaging a speed of one coach per minute, Whiting car washers easily handle up to 300 coaches per day. Models are available in one- or multiple-unit installations of the one-way or two-way types.

for Diesel-electric locomotives . . . Diesel-electric and other streamlined locomotives are cleaned quickly and efficiently by Whiting washers—locomotives move through the washer at a speed of 80 feet per minute. Hand grabs, window guards, and similar projections do not interfere with washing operations.



for buses . . . Whiting bus washers handle vehicles at a rate of 60 feet per minute, averaging one bus each 45 seconds. A single installation readily handles over 200 buses a day.

Washers can be set up either indoors or out.



Installation with two banks of brushes—one equipped for use with water and cleaning solution, other for use with water only.

Installation with reversing brushes which permit cars to be run through from either direction, as indicated.

WHITING CORPORATION

15609 Lathrop Ave., Harvey, Illinois

Offices in Chicago, Cincinnati, Detroit, Los Angeles, New York, Philadelphia, Pittsburgh, St. Louis, and Washington, D. C. Agents in other principal cities. Canadian Subsidiary: Whiting Corporation (Canada) Ltd., Toronto, Ontario.

RAILROAD MAINTENANCE EQUIPMENT

DROP PIT TABLES • LOCOMOTIVE HOISTS • HIGH-LIFT JACKS • LOCOMOTIVE SPOTTERS
CINDER CONVEYORS • TRANSFER TABLES • CROSSOVER BRIDGES • CAR WASHERS

BULLARD *Vertical* TURRET LATHES

BULLARD

Solve Tough Problems

This is the main reason why railroad shop supervisors prefer *Bullard Machines* for vertical boring and turning jobs. Economical production, precision and versatility are the well known characteristics of *Bullard* performance.

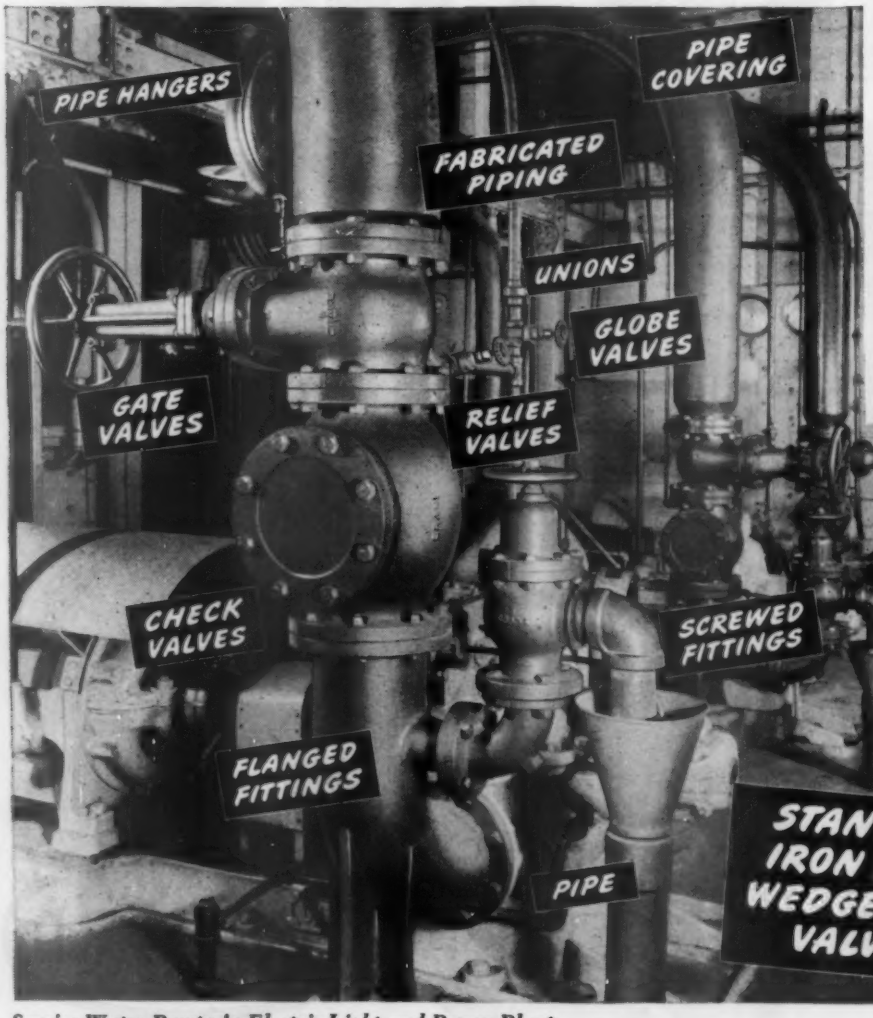
Above illustration shows a valve chamber head for a large power house air compressor being chucked on the face plate of a 54" V. T. L. It is an awkward piece to set up and center... precision is one of the most important requirements. When the job came into the back shop the machine tool foreman selected his new *Bullard*. Why? Because through years of experience he knew that the results would be perfect.

THE BULLARD COMPANY

BRIDGEPORT 2, CONNECTICUT

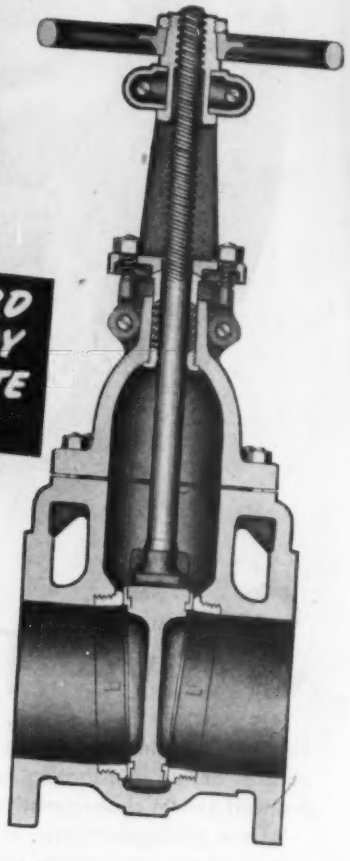
For every part of Piping Systems depend on the Complete Crane Line

ONE SOURCE OF SUPPLY . . . ONE STANDARD OF QUALITY
ONE RESPONSIBILITY FOR ALL PARTS



Service Water Pumps in Electric Light and Power Plant.

Valves, fittings, pipe, fabricated assemblies, piping accessories—for any service—Crane supplies them all! You choose from the world's greatest line of piping materials—in brass, iron and steel. One source—your Crane Branch or Wholesaler supplies all your requirements. Uniform quality in all parts—and one responsibility for them—helps you get the best installation. Keep this *complete* Crane service in mind to simplify and speed deferred replacement work—and to get full advantage of 90 years' leadership in the piping equipment field.



SERVICE RECOMMENDATIONS: **Crane Standard Iron Body Wedge Gate Valves** with brass trim are recommended for steam, water and oil lines; all-iron valves for oil, gas and fluids that corrode brass. Made in OS&Y and Non-Rising Stem patterns.

Working Pressures

Size of Valve	Screwed or Flanged Valves		Hub End Valves
	Saturated Steam	Cold Water, Oil, or Gas, Non-Shock	Cold Water or Gas Non-Shock
2 to 12 in.	125 pounds	200 pounds	200 pounds
14 and 16 in.	125 pounds	150 pounds	150 pounds
18 to 24 in.	*	150 pounds	150 pounds

*For steam lines larger than 16-inch, Crane 150-pound Cast Steel Gate Valves are recommended.

CRANE CO., General Offices: 836 S. Michigan Ave., Chicago 5, Ill. • *Branches and Wholesalers Serving All Industrial Areas*

CRANE **VALVES • FITTINGS • PIPE**
PLUMBING • HEATING • PUMPS

H. ARMSTRONG ROBERTS

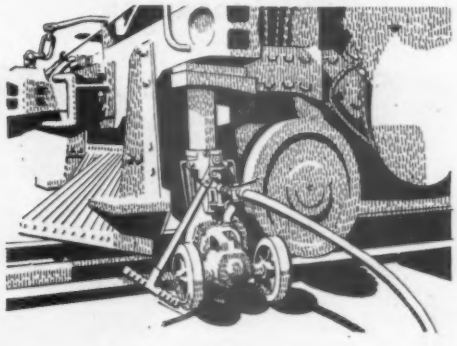
Duff-Norton Jacks

Duff-Norton Jacks provide the safe, speedy lifts that help cut maintenance and repair time and move equipment out of the roundhouse and back into service faster. Top quality Duff-Norton Jacks have been favorites with railroad men for many years because of their proven dependability and ease of operation. You can always count on Duff-Norton Jacks in your locomotive and car service work.

The Duff-Norton Manufacturing Co.
PITTSBURGH, PA.

Canadian Plant:
COATICOOK, QUE.

Representatives in Principal Cities

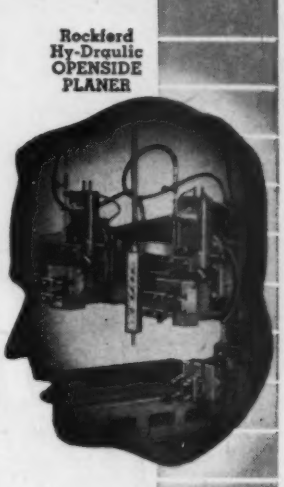


Duff-Norton Jacks
BUILT FOR RAILROAD SERVICE

The complete Duff-Norton line includes a Railroad Jack for every job and preference . . . from 100 tons capacity Rotary Air Motor Operated Power Jacks to the smallest manually-operated Screw Jacks. Our latest catalog tells the full story. Write for your copy.

Meet the "Heads"

of a Famous Family

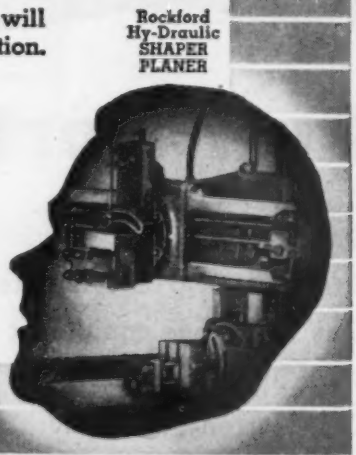


All these "heads" have one important factor in common. Each shows a means of using hydraulic power for smooth, precise, rapid cutting of metal. These are the heads of various Rockford Hy-Draulic machine tools.

When you seek machine tools for economical and profitable operation in a competitive world, investigate the advantages of Rockford Hy-Draulic Shapers, Planers, Slotters and Shaper-Planers. Easy, fast operation; and exact combinations of speed and feed for maximum production are two of many features in Hy-Draulic design which cut costs and increase production.

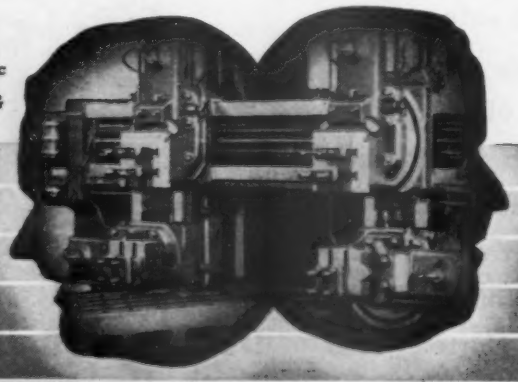
Bulletins are available describing the following Rockford Hy-Draulic machine tools: Shaper—12" stroke; Shapers—16" to 28" stroke; Openside Shaper—36" stroke; Planers, Openside and Double Housing, up to 60" x 60" and 20-foot stroke; Slotters—12", 20", or 36" stroke; Shaper-Planers 42" to 144" stroke.

Copies of any and all bulletins will be sent without charge or obligation. Please address Dept. 1916.



ROCKFORD MACHINE TOOL COMPANY

ROCKFORD ILLINOIS



WELLS' *Rod Saver* ELECTRODE HOLDERS GIVE

Performance Plus

—In Rod Economy

Model 4RS 400 amp. 10½" long. Weighs 18 oz.

This is why users in yards and shops all over the country have quickly learned that *Rod Savers* cut rod costs up to 14%:

- A streamlined holder that will stand up to heavy work, yet is still lightweight and easy to use in close quarters.
- Rod Saver grips rod only at uncoated end—all of rod can be used.
- Rod can be burned right down to last inch without over-heating insulator.
- High pressure grip guarantees better electrical contact with rod, more even burning, even with hot rods.

5886 Compton Ave. **Martin Wells** Los Angeles 1, Calif.

BAY CITY—Northern Supply Company
BIRMINGHAM—Ebbert & Kirkman Co. Inc.
CEDAR RAPIDS—L. B. Lamb Sales Co.
CHICAGO—Steel Sales Corp.
CINCINNATI—Williams & Co. Inc.
CLEVELAND—Williams & Co. Inc.
COLUMBUS—Williams & Co. Inc.
MILWAUKEE—Steel Sales Corp.
DETROIT—Steel Sales Corp.
Weldit Acetylene Co.
HOUSTON and throughout TEXAS—
Magnolia Airco Gas Products Co.
HONOLULU—Hawaiian Gas Products, Ltd.
MINNEAPOLIS—Steel Sales Corp.
MONTREAL—Rudel Machinery Co.
NEW YORK—Chicago Combustion Co.
VANCOUVER, B.C.—Scott-Foster & Co.
OMAHA—The Balbach Company
Fuchs Machinery & Supply Co.
PHOENIX—Arizona Welding Equipment
PITTSBURGH—Williams & Co. Inc.
SAGINAW—Northern Supply Co.
ST. LOUIS—Steel Sales Corp.
SAN FRANCISCO—Pitts & Loughlin
SPOKANE—Gibson Welding Supply Co.

AIR REDUCTION SALES CO. • OFFICES IN PRINCIPAL CITIES THROUGHOUT THE UNITED STATES

L&S GAP LATHES

FOR PISTONS AND MANY OTHER JOBS

EVERY railroad shop and engine-terminal handling classified repairs is a logical point for the installation of an L & S Gap Lathe.

Take for example your piston rod truing jobs—You do not have to remove the heads when you have an L & S Gap Lathe—All you have to do is to remove the Gap Lathe block.

There are lots of other jobs which, even though large in diameter, do not require the use of a heavy lathe. When such work is performed on an L & S Gap Lathe, a decided saving is made, not only on initial costs but also on operating and maintenance costs.

Lodge & Shipley Gap Lathes are obtainable in sizes from 12" to 27". A wide range of Engine Lathes, Tool Room Lathes, Manufacturing Lathes and Large Hole through Spindle Lathes with various attachments are available to suit your specific requirements.

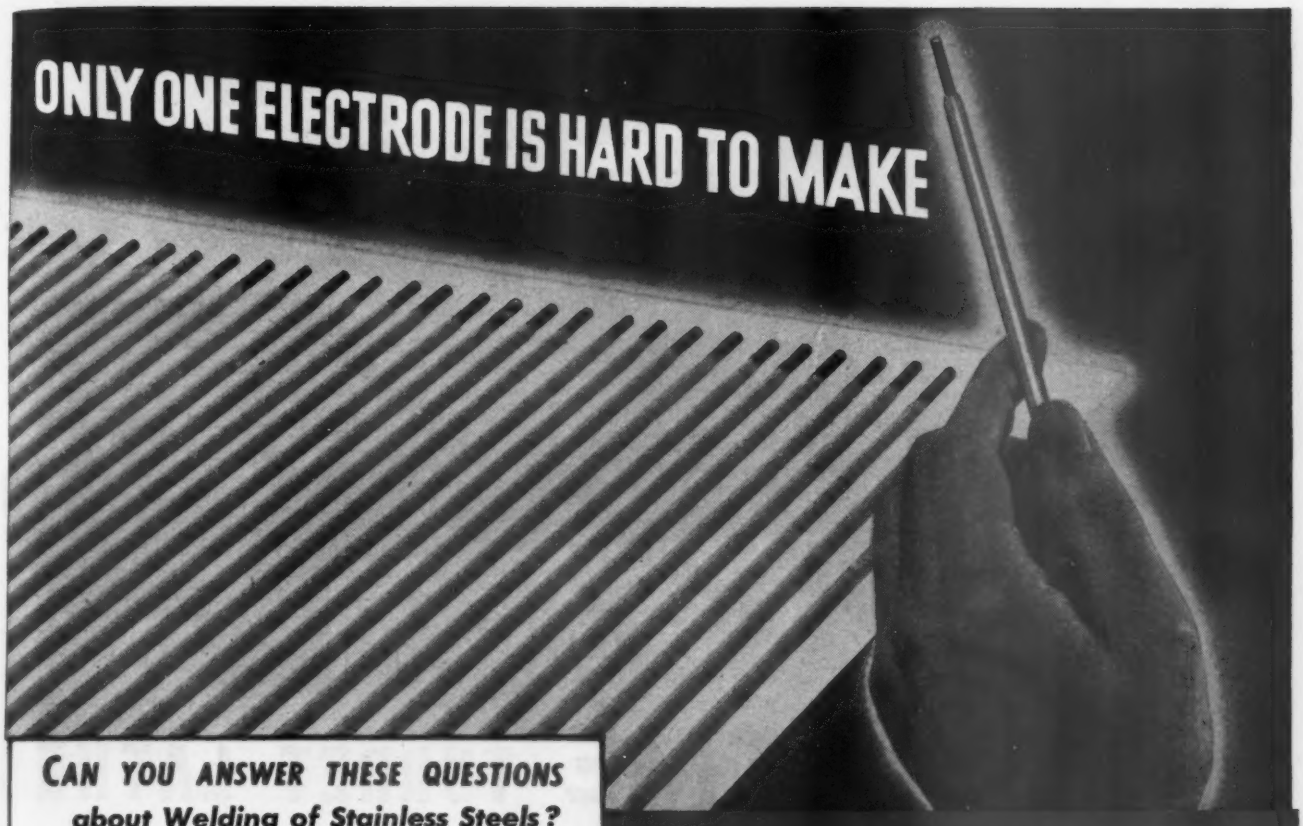
ENGINE
AUTOMATIC
TOOL ROOM
OIL COUNTRY
LATHES

THE LODGE & SHIPLEY MACHINE TOOL CO

CINCINNATI, 25, OHIO, U. S. A.

L & S LATHES

ONLY ONE ELECTRODE IS HARD TO MAKE



that's the FIRST ONE

The first electrode of a new type, or a definite improvement of an old one, is always hard to make.

Once the perfection of the "sample" is established, the ability to turn out millions of duplicates belies the difficulties overcome in the creation of that *first* satisfactory new one. Months, sometimes years, of research and experiment are necessary in our own laboratories and through our Fellowship at the Mellon Institute, to achieve the exact combination of physical properties, operating characteristics and standards of performance required of each new McKAY Electrode.

Thereafter, all others of the adopted type, are copies of the original.

That these "copies" may be faithful reproductions, McKAY assures uniform production by careful analyses of core wire and coating ingredients, constant supervision, frequent checks of production samples and rigid inspection.

So, from *first* to *last* . . . from research through production . . . McKAY mild, alloy and stainless steel electrodes are made to be better. Try them and see.

CAN YOU ANSWER THESE QUESTIONS about Welding of Stainless Steels?

	TRUE	FALSE
11. Molybdenum is added to stainless steels to increase their scaling resistance at elevated temperatures.	☐	☐
12. Not all stainless steels are classified by metallurgists as "austenitic."	☐	☐
13. Stainless steel electrodes are used on reverse polarity because they will not operate satisfactorily on straight polarity.	☐	☐

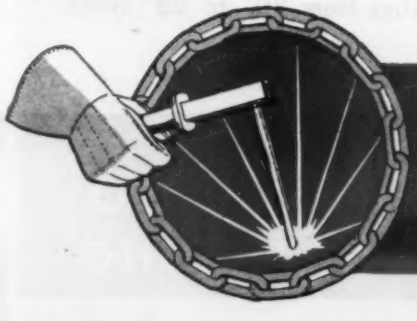
Answers: 11. False 12. True 13. True.

Questions 1 to 10, inclusive, have appeared in preceding advertisements. Other questions will appear next month. Watch for them!

Send for this Booklet

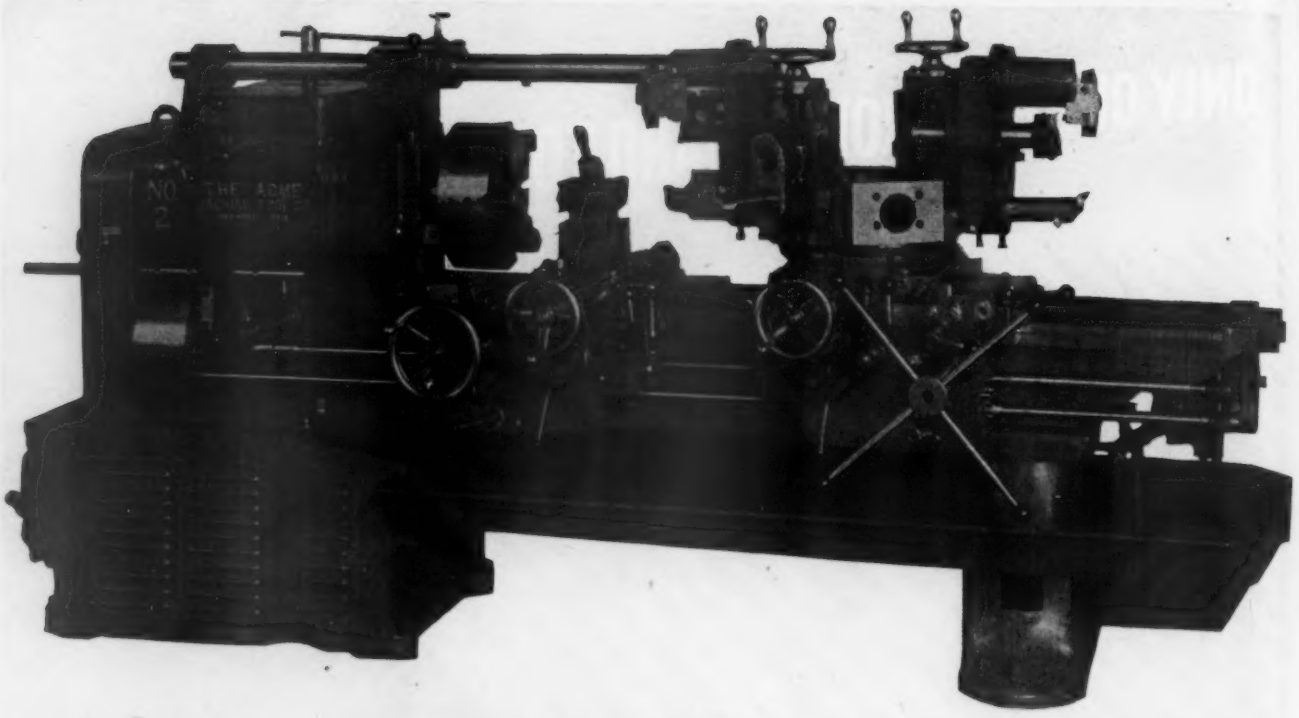
A limited number of these valuable booklets are still available for distribution. We shall be glad to send you a copy upon request. Ask for "Things to Know about Welding Stainless Steel."

GENERAL SALES OFFICES: YORK, PA.



THE McKAY COMPANY
PITTSBURGH, PA.

WELDING ELECTRODES . . . COMMERCIAL CHAINS . . . TIRE CHAINS



CINCINNATI ACME TURRET LATHES

Equipped With New Heavy Tools which Give More Rigidity and Greater Production Range

ACME MACHINE TOOL engineers are constantly searching for new ways and means to improve the efficiency and production rate of turret lathes.

They have developed a new line of Machine Tool Heads and Holders. These meet today's demands for power, high speed and accuracy improved by cemented carbide tipped cutting tools.

Vertical slide tools shown on the tooling setup, are used principally for finish boring operations, however, there is a wide range of operations that can be performed with this tool.

Other developments include the heavy duty multiple turning head with guide sleeve which takes its support on a rigid heavy stationary bar mounted on the headstock.

These heads have fixed center holes for holding cutter heads and a variety of tool holders which are designed to meet the latest requirements and are provided with cutting tools of very heavy cross sections.

Acme Turret Lathes are designed to insure maximum economies. They are available in bar capacities from 2" to 4½" diameter and in chuck capacities from 20" to 28" swing.

Our Engineers are at your service!

The ACME MACHINE TOOL CO. ... CINCINNATI, OHIO.

FLAMENOL *Showed No Aging*

THIS FLAMENOL CABLE, after six years' exposure to weather, without covering, is as good as new. Note the glossy, uncracked surface.
THIS OIL-BASE, RUBBER-INSULATED cable, exposed to identical conditions over the same period, is dull and badly cracked.
THIS MINERAL-BASE, RUBBER-INSULATED cable, after the same exposure, shows the same dullness and cracking as the oil-base rubber insulation.

IN THIS SIX-YEAR TEST UNDER FLORIDA'S SUN

Back in 1937, a large railroad company operating in the South, where climate is particularly unkind to cable insulations, decided to test the stamina of various types of insulation. Two of the samples tested were the usual rubber-insulated types; the third was Flamenol. None was protected by braid or other covering, so that insulation was exposed directly to sun and weather.

In 1943, after six years of continuous exposure, the three samples were taken down, and examined. The dramatically conclusive results are shown in the photographs above. Only Flamenol had stayed young!

FLAMENOL RESISTS ACID, ALKALI, OIL, AND WATER

Before the war, millions of feet of Flamenol cable had already been installed in factories, oil refineries, mines and railroads; places where its ability to resist most solvents and heat made it a "must." In the future, this proved-performance cable will find even wider fields of application in reducing maintenance costs and minimizing shut-downs due to insulation failure.

Note, at the right, Flamenol's operating, installation, and maintenance advantages. For complete information, ask our local office, or write to *General Electric Company, Schenectady 5, N. Y.*

11 OUTSTANDING ADVANTAGES OF *FLAMENOL*

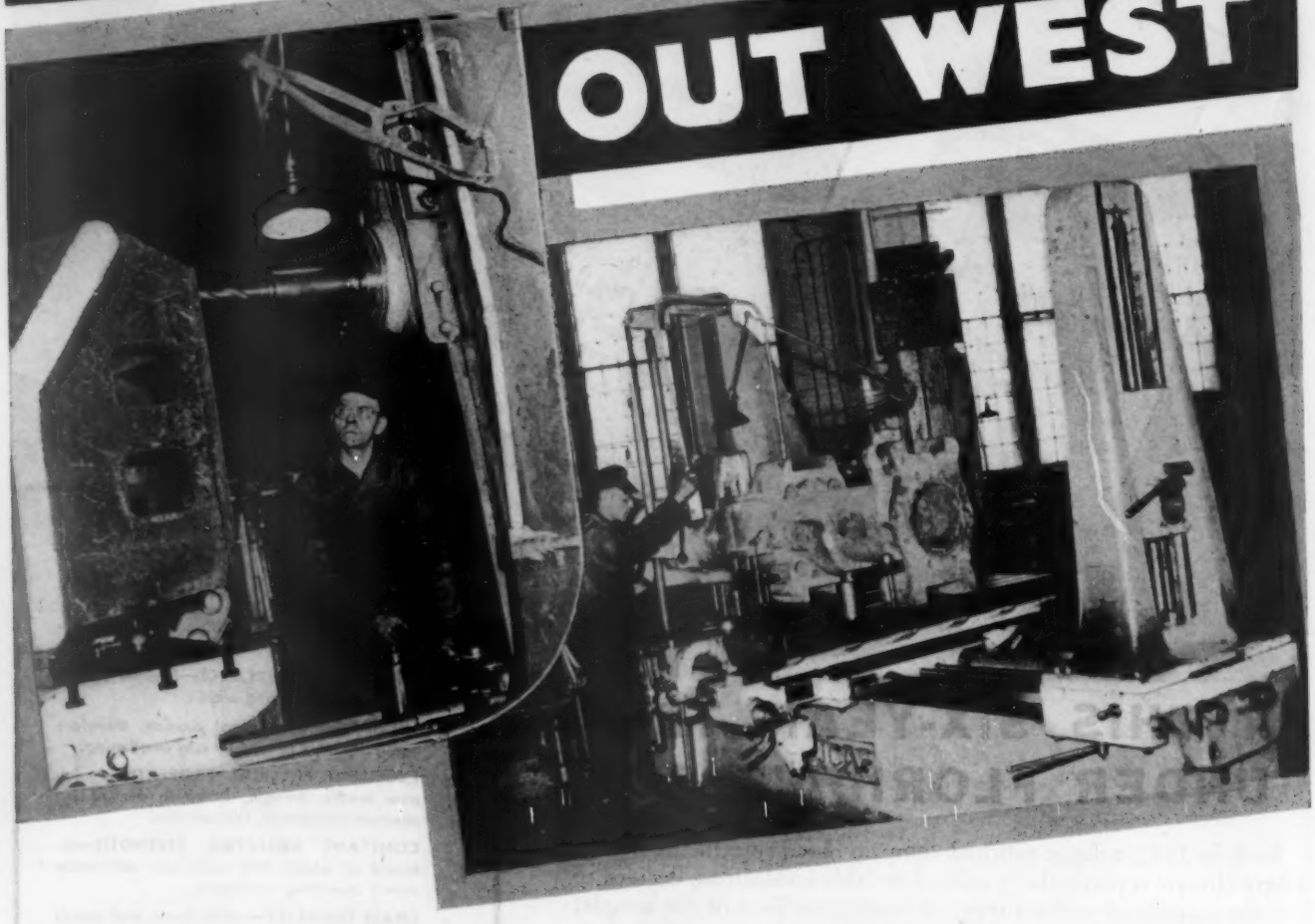
1. **FLAME RESISTANCE**—*will not support combustion.*
2. **CORROSION RESISTANCE**—*immune to action of oils, acids and alkalis.*
3. **SUPER-AGING**—*will not oxidize, therefore highly resistant to sunlight and weathering.*
4. **EXCELLLNT PHYSICAL PROPERTIES**—*minimum tensile strength, 1,500 lb per sq in.; minimum elongation, 100 per cent.*
5. **CONSTANT DIELECTRIC STRENGTH**—*retained at about 720 volts per mil under severe operating conditions.*
6. **SMALL DIAMETER**—*saves space, and speeds wiring.*
7. **SMOOTH SURFACE**—*facilitates pulling through conduit.*
8. **VARIETY OF COLORS**—*simplifies circuit tracing.*
9. **FREE STRIPPING**—*steps up installation, avoids weakening nicks on conductors.*
10. **WIDE RANGE OF CONSTRUCTIONS**—*aids selection for special applications.*
11. **SELF-PROTECTING FINISH**—*eliminates need for braid covering, saves space and weight.*

Buy all the BONDS you can—and keep all you buy

FLAMENOL INSULATED CABLE

GENERAL ELECTRIC

IN R.R. ACTION OUT WEST



LUCAS Nº 42 "PRECISION" MILL

INSTALLED about a year ago in a large Western railroad shop, the Lucas "Precision" Horizontal, Boring, Drilling and Milling Machine, illustrated above, has made a big hit — "We cannot praise too highly the qualities of this particular machine," stated the Shop Superintendent.

Illustration at left shows a combination Mallet type bumper and supporting bracket — All machining operations are performed on the Lucas. These consist of milling, drilling and boring hole for engine truck center pin.

The other illustration shows a job sent in by the Maintenance of Way Department — it is the steam portion of a pile driver hammer — Here the Lucas is called upon to machine the stuffing box, drill and tap for gland studs — recess for gaskets, bore the cylinder and mill the ways for leads. Yes! You can always keep a Lucas busy.

LUCAS MACHINE TOOL CO.

CLEVELAND, OHIO

SHOP TALK

Railroad men know that backshop work calls for cleaners that pack a wallop. This requirement is more important than ever in these days when America's railways are carrying unprecedented loads of vital war materials. Cars, locomotives and tenders can't wait between trips. They must be put in shape to go out on the road again at once.

That's why you hear Wyandotte Railway Cleaning Products spoken of so highly. Specialized to meet *every* cleaning need, they make short work of grit and soot, grease and carbon, oil and dirt deposits.

Helping railroad men save time on the turnaround is the Wyandotte Representative. He has a full line of maintenance and backshop cleaners that he'll gladly put to work for you. They'll do the toughest job efficiently and economically without upsetting any cleaning or washing program in existence.

Whatever your problem, the experience and training of the Wyandotte Representative is at your service at any time.

WYANDOTTE CHEMICALS CORP. • J. B. Ford Division, Wyandotte, Mich.
SERVICE REPRESENTATIVES IN 88 CITIES

Wyandotte
REG. U. S. PAT. OFF.

8 ALCO-G.E. DIESEL-ELECTRICS

Tankers—200 to 300 a day—are classified and transferred by the B&O's eight Alco-G.E. diesel-electrics on Staten Island. Oil traffic on this division has increased more than 100 per cent since the beginning of 1944, when the eight diesel-electrics released 17 steamers.

HOW *Alco-G.E. Diesel-Electrics*

"We can depend on our Alco-G.E. diesel-electrics being ready for work whenever they're needed," says J. J. Sell, Superintendent of the B&O's Staten Island Division. "This avoids delays and enables us to meet the precisely timed schedules set up for the rapid movement of—

"—hospital trains to junctions in New Jersey where other railroads are waiting to speed the wounded veterans to inland hospitals. We save time by coupling the diesel-electric to the train—

Alco GE AMERICAN LOCOMOTIVE

RELEASE 17 STEAMERS ABSORB 33% MORE TRAFFIC

WHILE ton-miles through the B&O's Staten Island terminals at St. George and Arlington climbed from 3,315,718 in July, 1943, to 4,418,867 in July, 1944, the motive power required took a decided drop—from 17 steam locomotives to eight Alco-G.E. diesel-electrics.

In addition, the diesel-electrics have an assignment that didn't exist two years ago: switching, classifying, and transferring as many as 120 passenger trains a month, most of which are important military movements.

Both jobs are being handled easily because, in these Alco-G.E. units, the inherent high availability of diesel-electrics has been further increased by low maintenance requirements. The only out-of-service time has been eight hours a month for I.C.C. inspection, resulting in an average availability of 98.7 per cent. That's why the B&O has been able to utilize them 87.3 per cent of the time and still have extra locomotive-hours available for emergency work.

This B&O operation is typical of how Alco-G.E. diesel-electrics are helping many railroads handle their heavily increased wartime traffic and, at the same time, make the necessary preparations for peacetime cost competition. How these locomotives can help you do both can be determined by a motive power survey on which our engineers will be glad to work with your own. Our recommendations will be impartial, because we build all three types of motive power—diesel-electric, electric, and steam.

INSURE THE PRECISE AND GENTLE MOVEMENT OF "TRAINS IN WHITE"

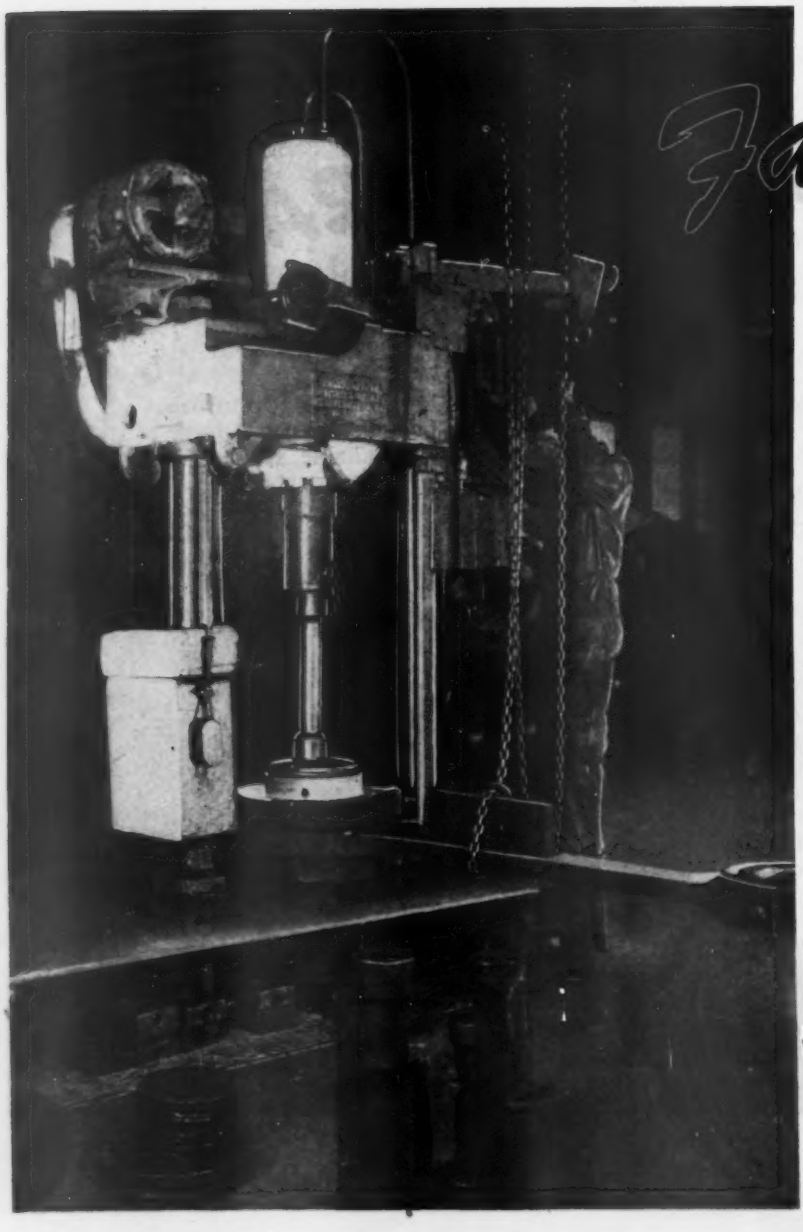
"—during loading operations. Their precise electric control makes coupling so gentle that even the most serious cases are not disturbed.

"And when the train pulls out, there's a gradual application of power—slack is taken up so smoothly that a drop of water wouldn't be spilled from a thimbleful on the rear platform of the last car."

115-115-9680

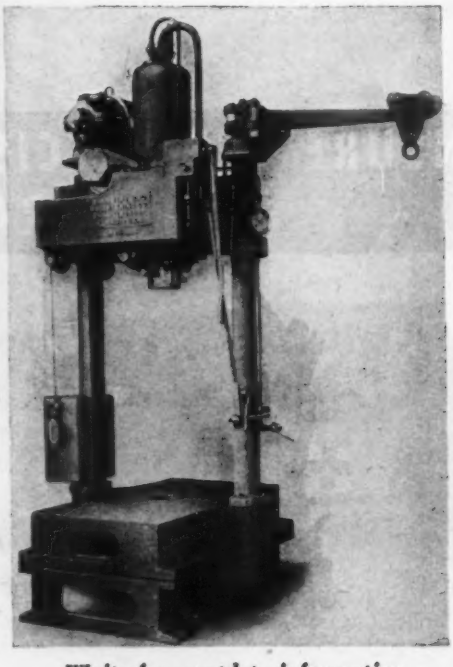
BUY WAR BONDS

and GENERAL ELECTRIC



Fast Work on BUSHINGS, BRASSES, etc.

Chambersburg Vertical Hydro-Pneumatic Bushing Presses are the most rapid machines available for inserting or removing connecting rod bushings, driving rod brasses, etc., and for bending or straightening rods, levers and all types of connections.



In addition to the speed of operation due to the pneumatic rapid traverse, the press is so designed that simplicity and ease of control make it a favorite with shop men. The ram, for example, can be advanced, stopped or returned without distracting the operator's attention from his work. Pressures can be applied and held indefinitely. Maintenance is easy and inexpensive.

Write for complete information on this and other Chambersburg Railroad Shop Tools . . .

CHAMBERSBURG ENGINEERING CO., CHAMBERSBURG, PA.

ARMY E NAVY

CHAMBERSBURG

HAMMERS · CECOSTAMPS · PRESSES

BALANCE

MEANS LONGER LIFE FOR RAILROAD EQUIPMENT

GISHOLT DYNETRIC BALANCING MACHINES*

Actual records show that reconditioned traction equipment, when properly balanced on Gisholt Dynetrics, has 2 to 3 times its original life. If you aren't taking advantage of Dynetric Balancing to keep equipment running longer and more smoothly, write us for full information.

**A development of Westinghouse Research Laboratories.*

FOR THE LOCOMOTIVE REPAIR SHOP

The Gisholt Type U Dynetric Balancing Machine is used for balancing traction motor armatures, Diesel-electric generator armatures, Diesel crankshafts, and other parts weighing from 250 to 6,000 pounds.

It takes but a few minutes with a Gisholt Dynetric to assure the accurate balance that eliminates the destructive vibration that causes excessive bearing loads, unnecessary wear and shortens the life of rotating parts. Whatever the part may be, from ½ ounce to 50 tons, there's a Gisholt Dynetric to handle it.

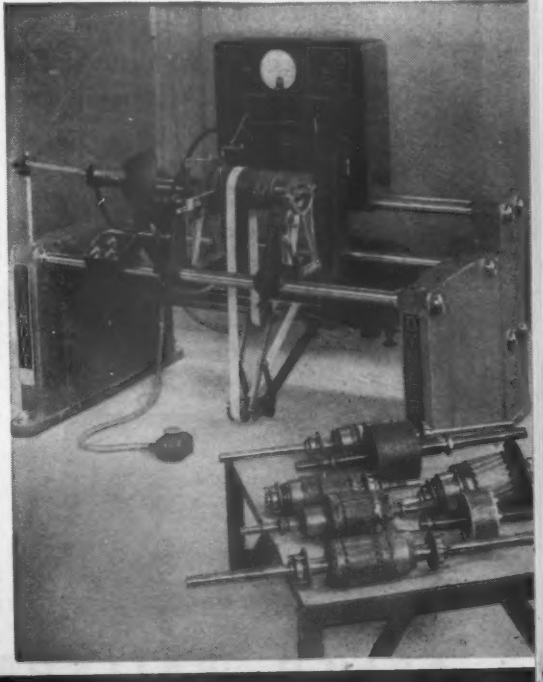
FOR THE ELECTRICAL SHOP

The Gisholt Type 3S Dynetric Balancing Machine is used for balancing auxiliary power generators, car heating, air-conditioning and ventilating equipment, and for any other rotating parts weighing from 15 to 300 pounds.

All auxiliary equipment is balanced by the original manufacturers. But it should be rebalanced when it is reconditioned to insure maximum life with the smoothest possible operation.

Gisholt Dynetric Balancing Machines are simple to operate, provide accurate static and dynamic balance more quickly and accurately than any other known means. Gisholt Balancing Machines soon pay for themselves in the longer life and reduced maintenance costs on many types of railroad equipment.

For complete information as to how Gisholt Dynetrics are being used in railroad shops, write us.



GISHOLT MACHINE COMPANY

1293 East Washington Ave. • Madison 3, Wis.

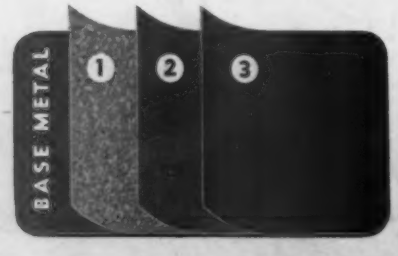
Look Ahead : : : Keep Ahead . . : With Gisholt Improvements in Metal Turning

TURRET LATHES • AUTOMATIC LATHES • BALANCING MACHINES • SPECIAL MACHINES

"Triple protection" is no empty phrase when you specify ARMCO ZINCGRIP-PAINTGRIP sheet steel for car roofs. This leaf-type drawing shows how the steel is protected three ways:

1. ARMCO ZINCGRIP: *A special zinc coating under—*
2. ARMCO PAINTGRIP: *A smooth, Bonderized finish that insulates zinc from—*
3. *Paint applied in any color.*

ZINCGRIP-PAINTGRIP has many advantages for car roofs. It can be drawn to the most intricate designs—without injuring the special zinc coating. No peeling or flaking, no unprotected seams to invite rust attack.



It Grips Paint

Next, the mill-Bonderized PAINTGRIP finish *holds* paint without costly pre-treatments. Less paint is needed because no primer coats are necessary.

These freight and passenger car roofs last longer and look better because PAINTGRIP retards drying-out of the paint. Maintenance and replacement costs go down and stay down.

You'll want to consider this special-coated sheet steel for car roofs and other applications where sheet metal must be formed and painted immediately. Shall we send you more data? Just address Armco Railroad Sales Co. Inc., 181 Curtis St., Middletown, O.

A Quick Check-List of Advantages

★

COMPLETE ZINC PROTECTION

★

LESS PAINT NEEDED

★

LONGER PAINT LIFE

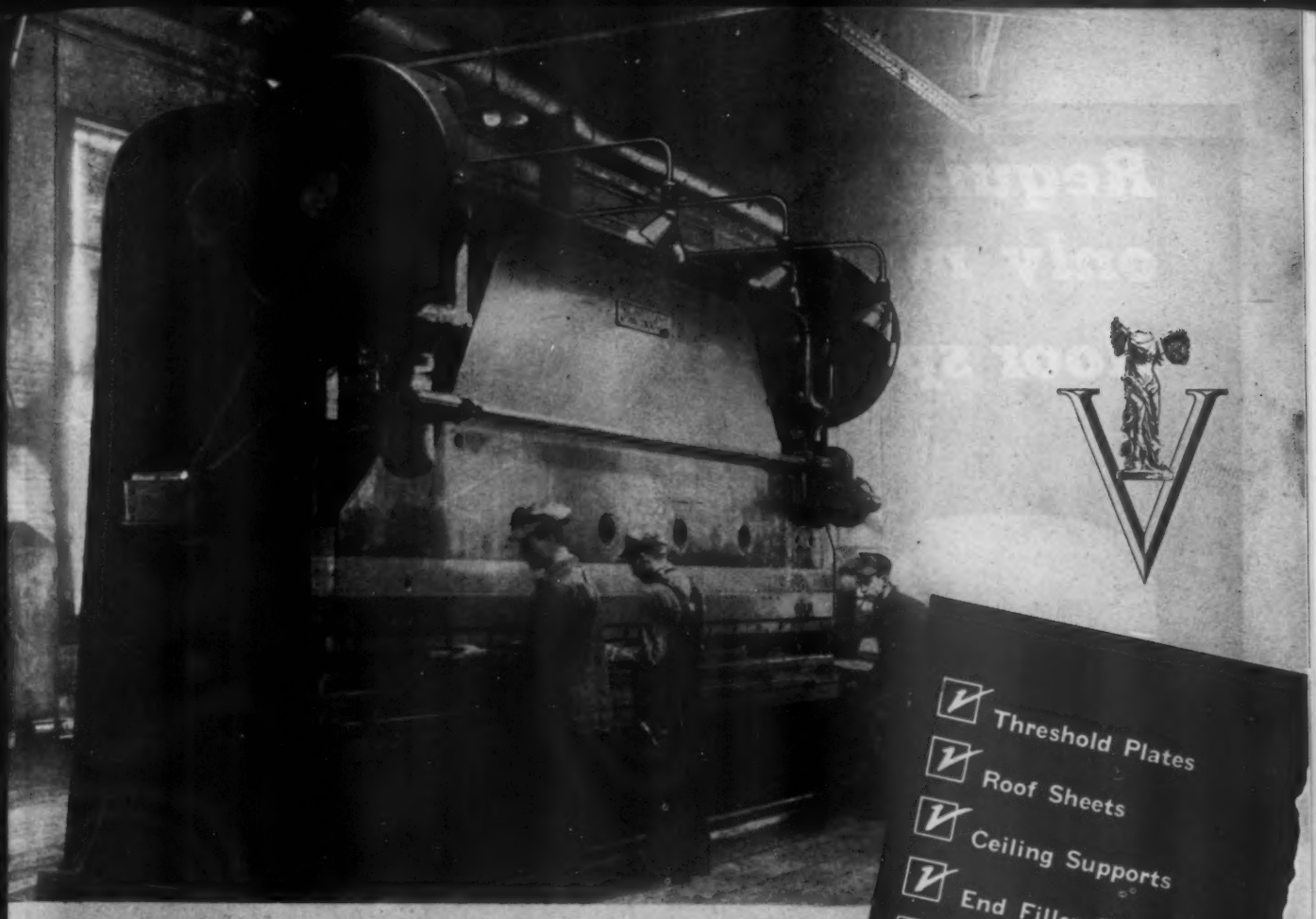
★

LESS MAINTENANCE

★

LOWER OVERALL COSTS

ARMCO RAILROAD SALES CO. INCORPORATED



Does them all ➡

- ✓ Threshold Plates
- ✓ Roof Sheets
- ✓ Ceiling Supports
- ✓ End Filler Clips
- ✓ Running-Board Brackets
- ✓ Water-Tank Shrouds
- ✓ Formed Angles, Tees and Channels

A great variety of punching and forming jobs are done by Cincinnati Press Brakes in railroad car shops. Their flexibility—ease and economy of change-over—make them extremely popular and profitable.

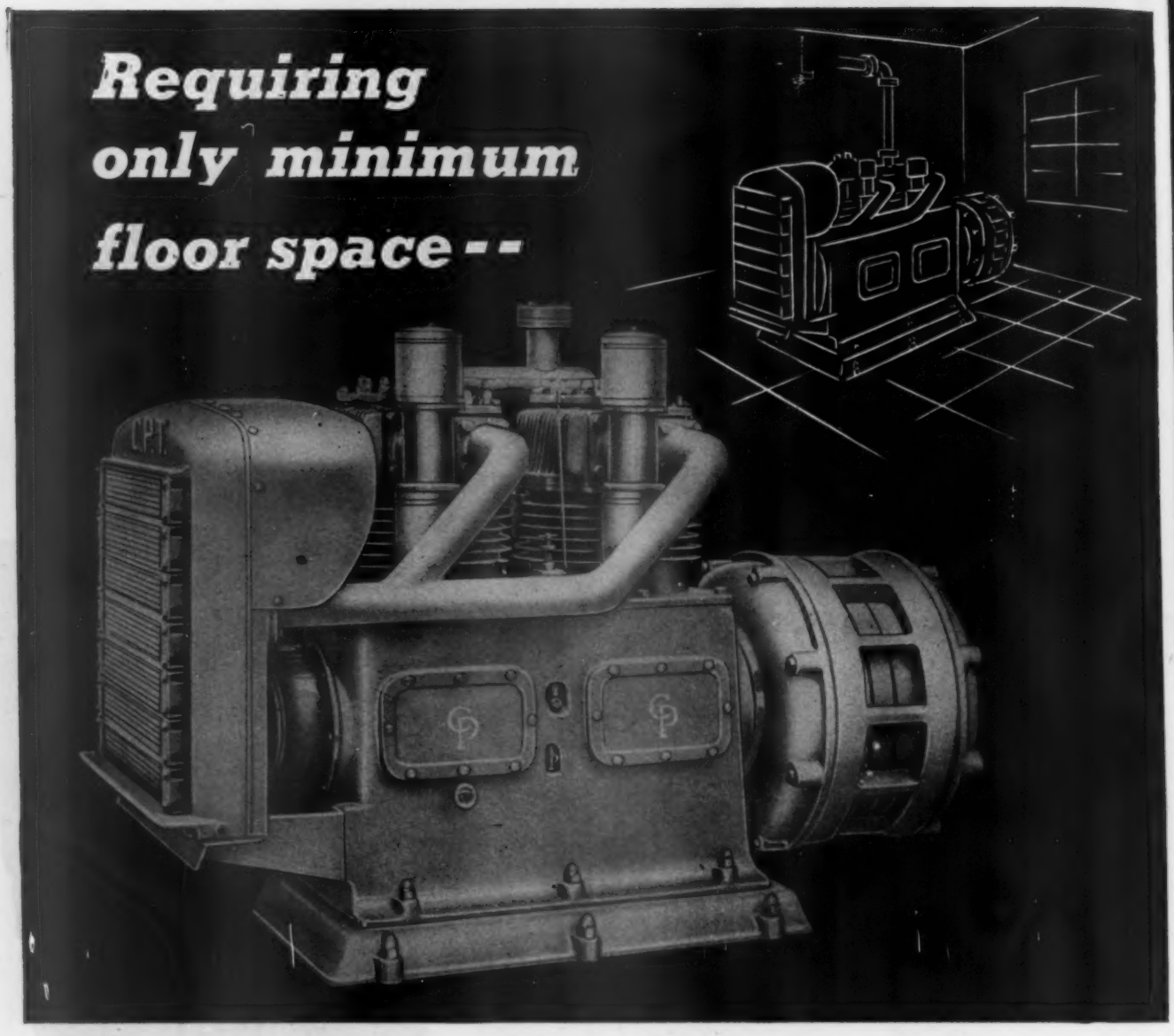
In the shop illustrated, the Cincinnati Brake is handling work ranging from the production of thirty 1/8" x 2" clips a minute to forming 3/8" steel plate sixteen feet long. Such adaptability keeps Cincinnati Press Brakes busy day in and day out.

Write for Catalog B-2, the book of many suggestions.

THE CINCINNATI SHAPER CO.

CINCINNATI OHIO U.S.A.

SHAPERS · SHEARS · BRAKES



CP Two-Stage Air-Cooled Compressors

EXTREMELY compact, Class PM Two-Stage Air-Cooled Compressors are ideal for installation where floor space is limited. Durable Simplate Valves, effective intercooling, inlet valve unloading system and force feed lubrication afford high efficiency and minimum maintenance.

Class PM Compressors are available in direct-connected type with built-in or coupled motor, or V-belt drive, in sizes ranging from 78 to 445 c.f.m. piston displacement, for pressures up to 125 pounds. Write for a copy of Bulletin 759, 5th Edition.

There is a CP Air Compressor, stationary or portable, for every air requirement from 25 to 10,000 c.f.m. actual capacities and for pressures up to 5,000 pounds.

★★★★★★★★★
PNEUMATIC TOOLS
ELECTRIC TOOLS
HYDRAULIC TOOLS
ROCK DRILLS

CHICAGO PNEUMATIC
TOOL COMPANY
General Offices: 8 East 44th Street, New York 17, N. Y.

★★★★★★★★★
AIR COMPRESSORS
VACUUM PUMPS
DIESEL ENGINES
AVIATION ACCESSORIES

2 Reasons why

RED LEAD

means Extra Rust Protection ...

Why is Red Lead so widely accepted throughout industry as *The* metal protective paint?

Why are paints containing Red Lead so generally specified for safeguarding metal surfaces from the costly ravages of rust?

The reasons are many, but none are more noteworthy than Red Lead's ability to counteract acid conditions and to halt electrochemical action—both prime causes of rusting—as explained at right.

Still another important advantage of Red Lead is that it partially combines with the usual vehicles to form compounds generally known as "lead soaps." Due to their composition and the individual way in which these compounds form, the film obtained is highly water-resistant. In addition, lead soaps contribute to the formation of tough, elastic films that "stick on the job."

Remember, too, that Red Lead is compatible with practically all vehicles commonly used in metal protective paints, including phenolic and alkyd resin types.

Specify Red Lead for ALL Metal Paints

The value of Red Lead as a rust preventive is most fully realized in a metal paint where it is the only pigment used. However its rust-resistant properties are so pronounced that it also improves any multiple pigment paint. No matter what price you pay, you'll get a better metal paint if it contains Red Lead.

NEUTRALIZES ACID

1 Red Lead has the ability to counteract acid conditions which are recognized as accelerators of rust. Structural steel is exposed to such environments because acid forming compounds are carried by the atmosphere in the form of gas, smoke and moisture. Red Lead has a neutralizing effect on these conditions as it is essentially a *basic* pigment with the ability to develop and maintain, for a prolonged time, a mild alkaline environment at the surface of the metal. Authoritative tests show that, as a result, Red Lead inhibits the process of corrosion. In short, metal paints, too, should "stay on the alkaline side."

2 Another outstanding reason Red Lead means *extra* rust protection is the unique way it shields metal surfaces with a protective film. Rusting is fundamentally an electrochemical process in which weak currents are generated which cause iron to become soluble in the lowest state of oxidation. Red Lead has properties through which this iron is rapidly converted to a stable compound that forms an adherent film. The formation of this protective shield halts electrochemical action, thus preventing further corrosion.

Write for New Booklet

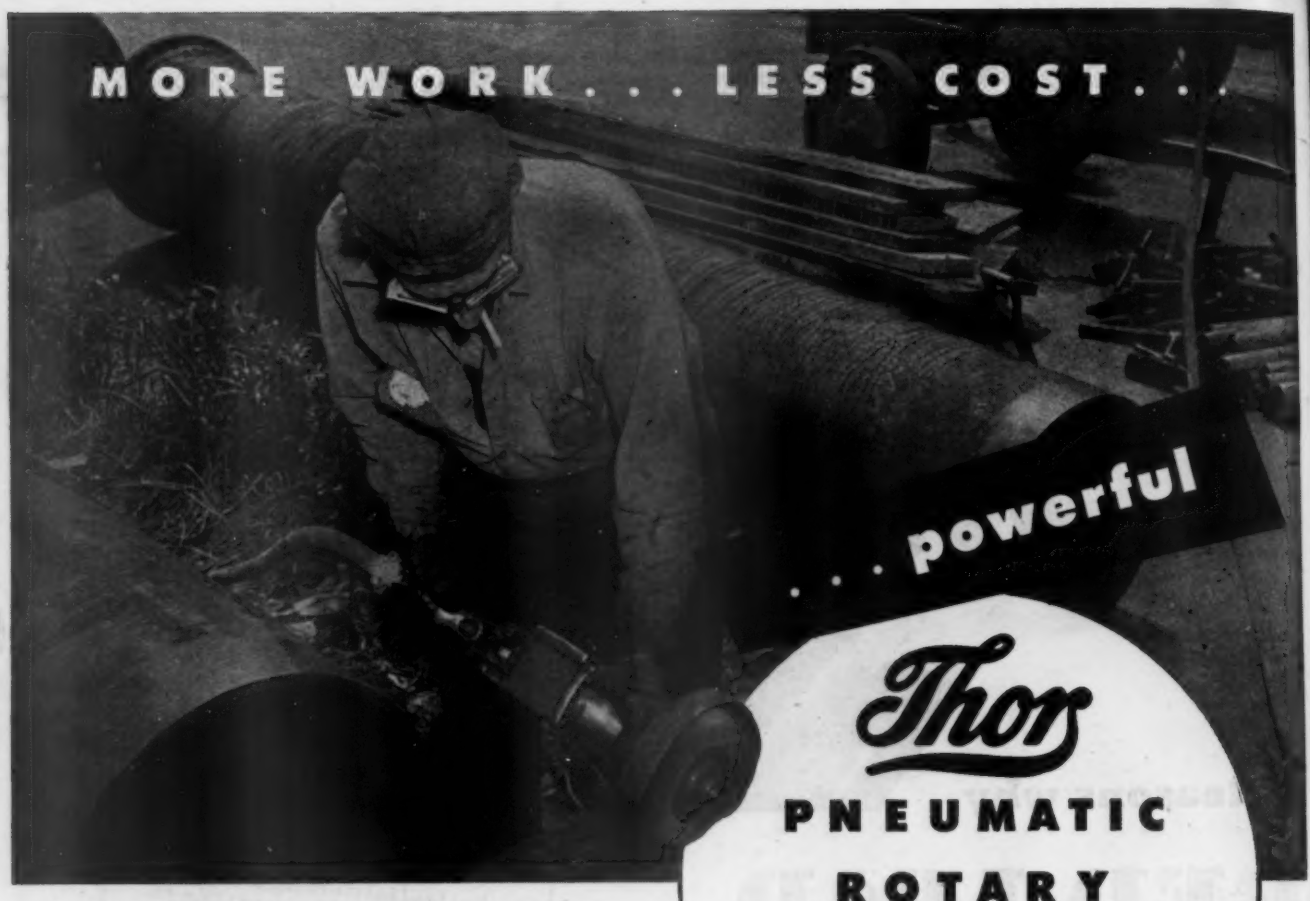
"*Red Lead in Corrosion Resistant Paints*" is an up-to-date, authoritative guide for those responsible for specifying and formulating paint for structural iron and steel. It describes in detail the scientific reasons why Red Lead gives superior metal protection. It also includes typical specification formulas. If you haven't received your copy, address nearest branch listed below.

* * *

The benefit of our extensive experience with metal paints for both underwater and atmospheric use is available through our technical staff.

NATIONAL LEAD COMPANY: New York 6, Buffalo 3, Chicago 10, Cincinnati 3, Cleveland 13, St. Louis 1, San Francisco 10, Boston 6 (National-Boston Lead Co.); Pittsburgh 30 (National Lead & Oil Co. of Penna.); Philadelphia 7 (John T. Lewis & Bros. Co.)

DUTCH BOY RED LEAD



Thor PNEUMATIC ROTARY GRINDERS

Save Time on Grinding Jobs

The advanced construction features of Thor Air Grinders are developments utilized by Thor to assure you of top speed—peak efficiency—maximum power—light weight and extra stamina for the toughest jobs:

1. THOR "Air Behind the Blades" principle keeps the rotor blades out against the cylinder bushing wall, preventing dead center position and assuring instant starting under all operating conditions.

2. The solid one piece construction of the THOR rotor permits the use of deeper blade slots and wider blades. This greatly boosts the power and the rate of material removal.

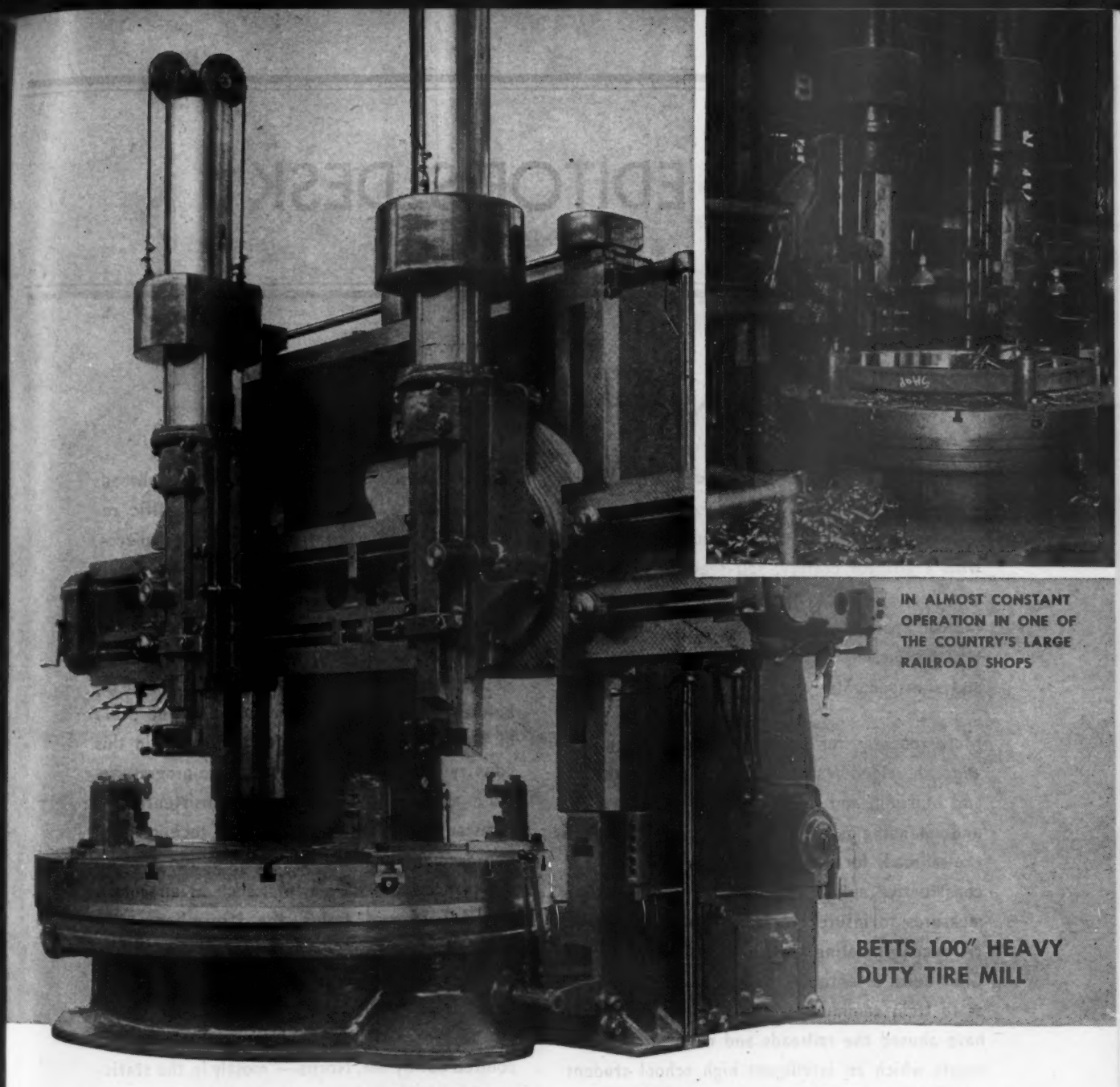
3. The THOR Double-Acting Safety Governor acts to save time in two ways: It regulates spindle speed to the level of highest grinding efficiency for the size and type of wheel used. It prevents racing of wheels at dangerously high speeds even in event of mechanical failure of governor parts.

You will find these top speed construction features, plus others like THOR End Exhaust, Automatic Lubrication, and Labyrinth Seal on Spindle, in a complete line of THOR Air Grinders for every industrial application. For details, write for THOR Pneumatic Catalog No. 52B.

Thor PORTABLE Electric & Pneumatic TOOLS

Branches in Principal Cities

50 THOR AIR GRINDERS
FOR EVERY TYPE OF JOB!
Thor Small Wheel Grinders
Thor Radial Wheel Grinders
Thor Surface Grinders
LOOK AT THE RANGE!
Number of Models 50
Wheel Capacities . . . 1½" to 8" dia.
Speeds . . . . . 3000 to 21,000 RPM
Lengths . . . . . 5½" to 39"
Weights . . . . . 18 oz. to 24 lbs.
INDEPENDENT PNEUMATIC TOOL CO.
600 W. Jackson Blvd., Chicago 6, Ill.
New York
Los Angeles



IN ALMOST CONSTANT OPERATION IN ONE OF THE COUNTRY'S LARGE RAILROAD SHOPS

BETTS 100" HEAVY DUTY TIRE MILL

WHERE SAFETY AND SERVICE DEPEND ON ACCURACY

Machines that bore locomotive tires must be thoroughly dependable . . . not alone for accuracy, but for fast, economical production as well. That is one of the reasons why Betts Tire Mills are employed for this exacting work. With them, tires are quickly centered by means of the Universal chuck. Specially designed, quick acting tire clamps hold the work securely in place for accurate machining. Anti-friction bearing table mounting further insures this machine's high standard of accuracy. Its adjustable crossrail provides capacity for other locomotive shop work.

BETTS • BETTS-BRIDGEFORD • NEWTON • COLBURN • HILLES & JONES • MODERN

CONSOLIDATED MACHINE TOOLS

CONSOLIDATED
MACHINE TOOL CORPORATION

ROCHESTER 10, NEW YORK

THE EDITOR'S DESK

RAILROADS NOT ASLEEP!

For many, many years—and even beyond the memories of most of us—the season has been open for attacks upon the railroads. Demagogues with a gift for oratory, self-seeking politicians, and people with little or no understanding of railroad operations and practices, have had a fine time figuratively tossing bricks at railroad owners and managements.

More recently, for instance, Drew Pearson, the widely heralded Washington columnist—strutting and bluffing, and quite obviously with no clear understanding of the problem—viciously attacked the railroads for their lack of aggressiveness and constructive ability in failing to adopt certain measures to insure greater safety of operation. (A recent meeting of the New York Railroad Club quite effectively showed up his ignorance as to train communication.) Ranting politicians have abused the railroads and made pronouncements which an intelligent high school student with a little unbiased study could controvert.

These misleading statements have been so overplayed that the average intelligent citizen has awakened to their viciousness. Certain railroad chief executives are also doing much to educate the thinking public by taking the platform and, without oratory but in a forceful way, pointing out those steps which have been taken over the years to build an effective transportation machine by adopting the best facilities and practices that science and engineering have made available.

The old bogey—the charge that the railroads have failed to take advantage of scientific research—has been pretty well shot to pieces, except in the eyes of those who quite deliberately choose not to see.

As President E. E. Norris of the Southern Railway so effectively pointed out in a recent address before the Chamber of Commerce of the State of New York, "There are few industries in this country that have been and are more progressive, more alert to invention, more consistently interested in scientific research and technological improvement than the railroads." While some of the pioneering achievements, such as air-conditioned passenger trains, the streamliners and Diesel locomotives, have captured the public fancy, most of the technological progress on the railroads has been behind the scenes and shows up, so far as the public is concerned—and as pointed out by Mr. Norris—"mostly in the statistics of safety, of tonnage handled, dependability, economy, efficiency—and sometimes solvency in the face of pyramiding costs and declining revenues."

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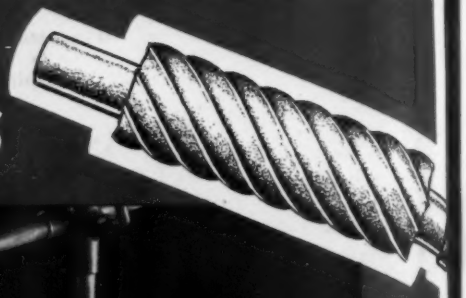

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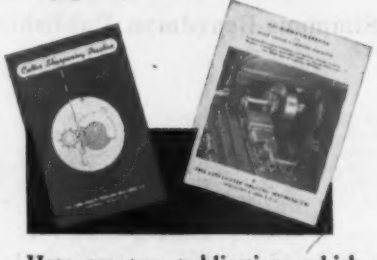

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TOOL ROOM AND MANUFACTURING MILLING MACHINES . . . SURFACE BROACHING MACHINES . . . CUTTER SHARPENING MACHINES

Carry-Over from Boilers*

By Arthur Williams†

A discussion of the nature of carry-over – Its effect on the locomotive and on the superheater – A steam separator system for eliminating carry-over described and the results of tests recorded

In this paper, carry-over is defined as any substance leaving the boiler other than dry steam. This includes moisture in any form, regardless of the mechanism which caused it to enter the steam path, as well as suspended solids.

In approaching the problem of carry-over in locomotive boilers some tests were made in the laboratory of the Superheater Company at East Chicago, Ind., in 1939. The results are shown in Table I, each line being the average of several tests. These tests showed that under conditions approximating the worst that may be found in locomotive operation, it was possible for foam to carry a very high percentage of moisture, and that it should not be difficult to collapse this foam. This would indicate the desirability of an apparatus to collapse the foam and to be capable of discharging large amounts of moisture.

In 1938, a series of investigations was started by the Electro-Chemical Engineering Corporation and Dearborn Chemical Company to study visually the behavior of the water and steam in a locomotive boiler. Tests made on the St. Louis-San Francisco, Texas & Pacific, and Kansas City Southern led to an elaborate investigation on the Missouri Pacific. As a result of these tests the "Electromatic" foam-collapsing system was developed.

The effects of carry-over will, of course, depend upon the nature of the substances leaving the boiler. The greater part of carry-over is usually moisture but it is possible to have an appreciable amount of solid matter. Table II gives the analyses of scale found in superheater units from eleven different railroads in all parts of the country. It can be assumed that some of this matter would find its way into the multiple throttle, valve chests, and cylinders. In most cases, there is a high proportion of silica and alumina. With such substances being carried into the valve chests and cylinders, it can easily be understood why carry-over will cause rapid wear of bushings and packing. At the same time, lubrication will be adversely affected and wear of reciprocating parts accelerated. The analyses are arranged in descending order as to the percentage of silica and alumina taken together. As the percentage of these two substances decreases, the amount of oil and other organic matter increases.

Probably the worst effect of carry-over is in relation to the superheater. For a given operating condition the amount of heat taken up by the superheater units is fixed, and the moisture entering the superheater will reduce the final steam temperature, since some of the heat will be required to evaporate this moisture before superheating can begin. Steam tables show that for the same heat ab-

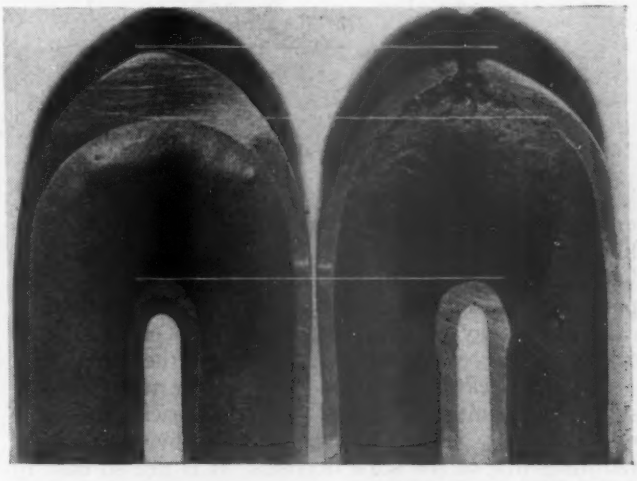


Fig. 1—New and failed superheater-unit return bends

Table I—Tests with Foaming Solutions

Test series No.	Boiler pressure, lb. per sq. in.	Water temp ent boiler, deg. F.	Quantities leaving boiler, lb. per hr. Total steam and moisture	Dry steam	Moisture	Liberation rate, lb. per hr. per sq. ft. water surface	Moisture from boiler, per cent	Remarks
1	194	368	518	216	302	998	58.3	5,000 p.p.m.* (292 grains per gal.) soap
2	192	348	1280	238	1042	2470	81.4	5,000 p.p.m. (292 grains per gal.) soap
3	182	363	422	223	199	814	47.2	1,400 p.p.m. (82 grains per gal.) sodium salts; 80 per cent sodium sulphate, 20 per cent sodium chloride
4	181	365	1797	159	1638	3460	91.2	2,800 p.p.m. (163 grains per gal.) sodium salts; 80 per cent sodium sulphate, 20 per cent sodium chloride

* Parts per million.

* From a paper sponsored by the Railroad Division and presented at the annual meeting of the American Society of Mechanical Engineers at New York on November 30, 1944.

† Chief engineer, The Superheater Company, East Chicago, Ill.

Table II—Analyses of Scale in Superheater Units

Sample	1	2	3	4	5	6	7	8	9	10	11
	Per cent										
Oil	0.05	0.05	0.08	0.33	0.06	0.08	2.25	1.40	1.01	23.90	Present
Other organic and volatile	1.67	...	1.30	6.04	5.20	...	4.12	0.40	11.26	13.05	32.80
Silica	16.23	39.35	51.05	37.07	31.36	37.62	33.80	9.70	7.36	12.10	6.85
Calcium carbonate	22.42	14.70	4.60	3.16	17.82	37.07	37.93	19.55	50.88	24.10	41.80
Lime*	...	3.27	...	17.11	...	...	...	...	...	...	...
Calcium sulphate	...	0.88	Trace	0.56	12.08	Trace	1.30	0.88	0.06	6.47	...
Magnesia	0.60	2.91	24.84	3.04	1.89	15.35	10.58	4.49	4.65	5.75	10.53
Iron oxide	5.02	17.6	10.82	3.62	10.00	4.00	5.62	40.00	4.50	9.20	2.49
Alumina	47.94	21.16	7.00	16.70	20.64	5.70	4.00	23.00	19.53	2.40	2.00
Sodium chloride	...	...	0.31	1.75	...	0.08	0.40	...	0.21	...	...
Sodium sulphate	3.43	...	...	...	...	...	...	...	...	...	...
Alkalies	2.64	...	...	10.00	...	...	...	0.58	...	3.03	3.55
Oil and other organic matter	1.7	0.05	1.4	6.4	5.3	0.8	6.4	1.8	12.4	37.0	32.8
Silica and alumina	64.2	60.5	58.1	53.8	52.0	43.3	37.8	32.7	26.9	14.5	8.9

* In combination with other oxides.

sorbed per pound of steam, there is a decrease in superheat of approximately 15 deg. for each one per cent moisture entering the superheater. A loss of 15 deg. steam temperature means a decrease of 1.5 to 2 per cent in cylinder efficiency with a corresponding increase in water and fuel consumption. A severe carry-over will result in the loss of all the superheat, so that saturated steam and water will enter the cylinders.

Tests made many years ago showed that the use of superheated instead of saturated steam resulted in an increase of 25 to 30 per cent in efficiency and power. These tests were made with relatively low superheat. With modern high steam temperatures, the loss of power due to loss of superheat can be even greater.

With large sums of money being spent for fuel it is readily seen that carry-over may cause an appreciable increase in the fuel bills. Furthermore, the carry-over is likely to occur when the locomotive is being worked at its hardest. This means that, at a time when the maximum power output of the locomotive is required so that train movements may be made with maximum efficiency, the carry-over decreases the power output of the locomotive.

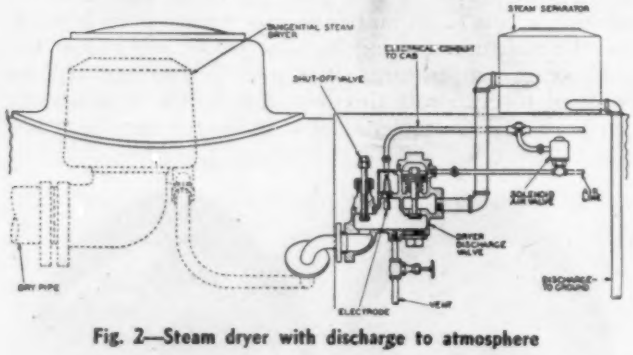


Fig. 2—Steam dryer with discharge to atmosphere

Continued carry-over may result in the failure of the superheater units in service. When the back end of the unit is heavily coated with scale, it is obvious that the failure is due to the scale deposits. It is not so easy to understand those failures which occur in actual practice when the metal is practically free from scale.

Assume that a locomotive is being worked at high capacity, which means a high temperature of the gases at the back tube sheet and a high gas velocity in the superheater flues; under these conditions, there should be a correspondingly high steam velocity inside the superheater-unit tubing. Now assume that in one unit the steam flow is restricted, such as would occur if there were a scale deposit at any point in the tubing between the entrance and exit. One effect is that the steam temperature leaving this particular unit will increase because there is a reduction in the weight of steam and, therefore, an increase in the heat added per pound of steam. Furthermore, the decrease in the steam velocity will lower the heat-transfer coefficient at the inside surface of the tubing. Both these effects increase the metal temperature. A reduction in the proper steam velocity will give an appreciable increase in the metal temperature. With a steam flow approximately 50 per cent of normal, the metal temperature reaches 1,015 deg. F. and with 23 per cent of normal, the metal temperature is 1,200 deg. F. At such temperatures, there is a rapid attack on the steel by steam.

A number of investigations have been made at Purdue University to determine the corrosion rate of various steels in contact with steam at elevated temperatures. The results for mild steel show a slight amount of corrosion at 1,000 deg. F. At 1,050 deg. F., the corrosion rate starts to increase rapidly. At 1,200 deg. F. the corrosion rate is 15 times greater than that at 1,050 deg. F.

In comparing laboratory tests with the results obtained under service conditions, consideration must be given to the effect of alternating thermal and mechanical stresses in the metal which tend to cause fissures through which the steam can reach the metal. In this respect, the conditions in a locomotive superheater are perhaps the worst that can be imagined. Every change in the locomotive operating conditions results in a change in the temperatures and stresses in the superheater-unit metal. It is the combination of elevated metal temperatures and alternating stresses which results in the rapid deterioration of superheater units reported in a number of cases. The failure may occur in the superheater-unit return bend or in the tubing close to the return bend.

Fig. 1 shows a return bend that has failed in service. For comparison, a new return bend made by the same process and of identical material is also shown. The black material at the inside edge of the failed return bend is magnetic oxide. Comparison of the inside contour of the

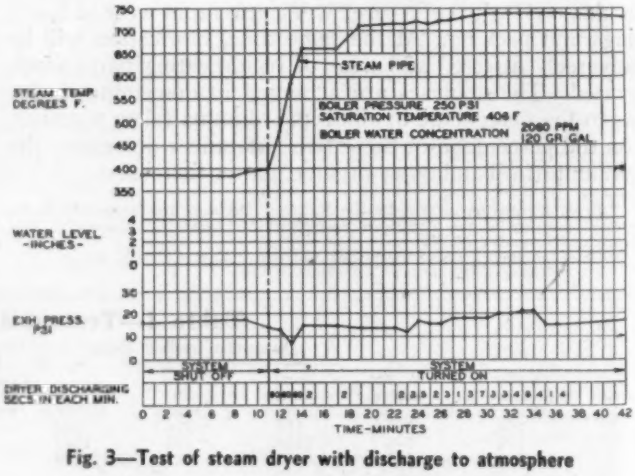


Fig. 3—Test of steam dryer with discharge to atmosphere

two return bends indicates the continual process of formation of magnetic oxide and subsequent breaking away of part of the layer. The process continues until the metal becomes sufficiently thin for steam pressure to rupture it.

With the metal at elevated temperatures, there will also be corrosion of the steel by the oxygen in the flue gases in contact with the outside of the unit. The extent of this corrosion will depend upon the condition of the outside surface of the unit. It will usually be less when coal is used as a fuel than with oil. This is because there is usually some slag formation at the back end of the unit with coal. With an oil burner the sanding of the flues will keep the metal surface clean and allow increased contact between the steel and the oxygen.

The prevention of carry-over may be accomplished by control of the foaming, the removal of the foam after it is formed, or a combination of the two methods. In the first group are feedwater treatment, antifoam compounds, and control of concentration for the operating conditions.

For given operating and feedwater conditions, the most general method for controlling carry-over is by blowing down the boiler to reduce the concentration of solids. Since this reduces both the dissolved and suspended solids it does not make a great deal of difference which is the more important in the production of foam. The blowing down may be done in any of three ways:

1—With manual control by the engine crew. If the boiler water concentration is controlled by this method only, it is necessary for the supervisory forces to give proper instructions to the engine crews so that the blowing is in correct relation to the feedwater and operating conditions. The most common method of control is to take samples of the boiler water at the beginning and end of each run and to keep records of the concentrations.

2—By a continuous blow down. With this type of equipment, a predetermined quantity of water is continuously discharged to the atmosphere while the locomotive is working. The blow-down valve is automatically opened in response to steam-chest pressure.

3—Intermittent blow down, automatically operated by the conditions existing in the boiler at the time. This is accomplished by a device known as the "signal foammeter."

Another system consists of a steam separator in the boiler connected to a discharge valve on the outside of the boiler so that any carry-over is blown to the atmosphere. The arrangement of the apparatus is shown in Fig 2.

Previous investigations had shown the possibility of large quantities of moisture being carried over under foaming conditions. Considerable development resulted in a design of steam separator known as the "tangential dryer," which is extremely efficient at all steam velocities and is capable of handling high percentages of moisture.

Referring to Fig. 2, the tangential dryer is located at the dry-pipe entrance. The discharge from the dryer through which the separated moisture is delivered is connected to a discharge valve mounted on the outside of the boiler. When any moisture is carried into the discharge valve, an electrical circuit is completed through an electrode to operate a relay which opens a solenoid valve. This admits air to the piston which operates the discharge valve. The discharge from the valve is connected to a separator on top of the boiler so that the steam is discharged to the atmosphere and only hot water to the ground. A vent pipe with a small orifice leads from the discharge valve to a point of lower pressure, such as a superheated steam auxiliary pipe. The small quantity of steam which flows through the orifice keeps the discharge valve free of air and establishes a flow condition which insures the prompt action of the valve as soon as moisture enters the steam dryer.

To determine the performance of the dryer discharge valve, tests were run on a western railroad which was known to have very bad foaming conditions. During the tests the boiler evaporation was from 70,000 to 100,000 lb. of steam per hr. The tangential dryer was fitted to a 9½-in. dry pipe, and the 2-in. dryer discharge valve had a capacity of 40,000 lb. per hr. of saturated water at boiler pressure. The performance of the dryer discharge system was determined by comparative tests made with the system turned on and shut off. The test results are given in Figs. 3 to 5, inclusive. These tests were run over the same territory on three successive days, with the last two

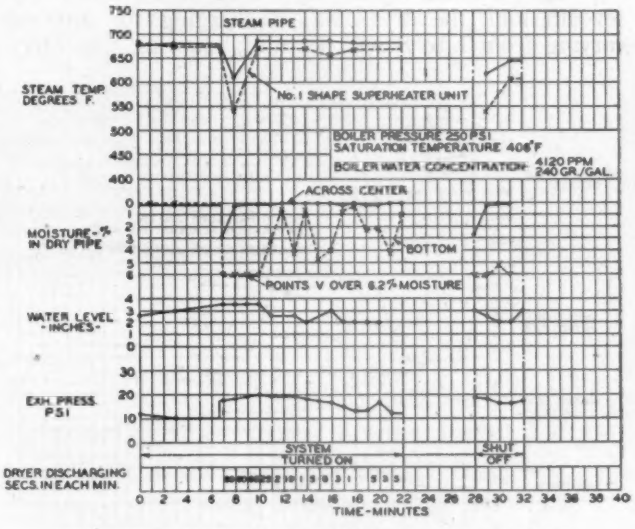


Fig. 4—Test of steam dryer with discharge to atmosphere

series being run on the same day, so that as far as possible the tests with the system turned on and shut off were made under the same conditions.

The steam temperature was taken in the steam pipe and also leaving a No. 1 shape superheater unit. This is in the top row of units and is connected into the header at a point nearest to the dry-pipe entrance. Moisture naturally flows first into this shape unit and its presence is indicated by the difference between the temperature of the steam leaving the unit and the steam-pipe temperature. The moisture in the dry pipe was measured by two throttling calorimeters. One was connected to a standard A. S. M. E. sampling tube across the center of the dry pipe. Since the tangential dryer imparts a whirling action to the steam, a second calorimeter was connected to a sampling tube, consisting of a piece of ½-in. pipe extending into the bottom of the dry pipe ¼ in., with the side toward the direction of flow cut away.

The four readings mentioned gave an indication as to the extent of carry-over into the superheater. Sight glasses were installed in the dome cover so that visual observation could be made of the conditions inside the boiler. Readings were taken of the water level and the exhaust pressure, the latter being a measure of the rate of working of the locomotive. A record was made of the number of seconds in each minute of testing that the dryer discharge valve was open. A short electrode mounted in the dome cover would operate a signal light in the cab when the water-and-steam density was sufficient to complete an electrical circuit.

The results are given in the form of curves showing the change in the various observations for each minute of testing. The first test, shown in Fig. 3, does not in-

clude all of the readings taken in subsequent tests, but is reported because it illustrates a very bad condition of carry-over. With the boiler under foaming conditions, readings were taken for the first 11 min., recorded in Fig. 3, with the dryer discharge system shut off. The steam temperature in the steam pipe was at boiler saturation temperature, and water was being thrown out of the stack and through the cylinder cocks, which were open. After 11 min., the dryer discharge system was turned on. The discharge valve opened and blew steadily for 3 min. and at short intervals thereafter. At the end of 3 min. the steam temperature had increased from 400 to 660 deg. F. and 19 min. after the dryer discharge valve had been opened the steam-pipe temperature had reached 740 deg. F. From the twenty-second min. to the thirty-seventh min. the dryer was discharging for intervals varying from 1 to 8 sec. per min., showing that carry-over into the dryer was still occurring, and that the moisture and solids were being separated and discharged to the atmosphere.

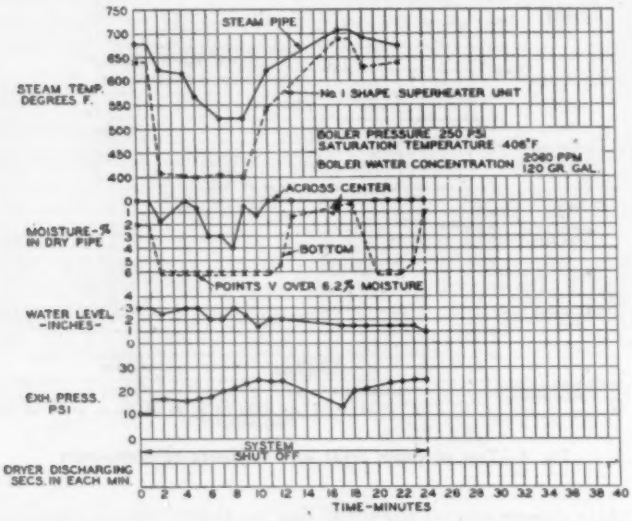


Fig. 5—Test of steam dryer with discharge to atmosphere

After this test, it was realized that it would be better to produce a standard test condition so that the locomotive operation with and without the dryer discharge valve in action could be determined. Fig. 4 shows how this was done. The locomotive was operated at approximately 10 lb. exhaust steam pressure and, when conditions were steady, several readings were recorded. The rate of evaporation from the boiler was then suddenly increased by increasing the cutoff, and observations were made of the results of the carry-over.

Referring to Fig. 4, the rate of evaporation was suddenly increased just before the seventh min. as indicated by a rise in the exhaust pressure from 10 to 18 lb. per sq. in. Immediately, carry-over started and the dryer discharge valve opened. For 3½ min. the dryer discharge valve was open continuously. There was a momentary drop in the steam temperatures and increase in the dry-pipe moisture, but after 3 min. the steam-pipe temperature was back to normal, and the steam temperature leaving the No. 1 shape unit showed only a slight amount of moisture. The calorimeter connected to the center sampling tube showed dry steam, and that connected to the bottom showed some moisture.

It should be pointed out that, while the moisture readings are represented as actual quantities, they should not be interpreted too literally. It is only possible to obtain a true sample when the steam-and-water mixture is homogenous, and this is not possible in a dry pipe after the steam has left a dryer which has subjected the steam and water to a centrifugal action. At the end of the test shown in Fig. 4, a few more readings were taken with the dryer discharge system shut off. These readings show moisture entering the superheater as indicated by the steam-temperature and calorimeter readings.

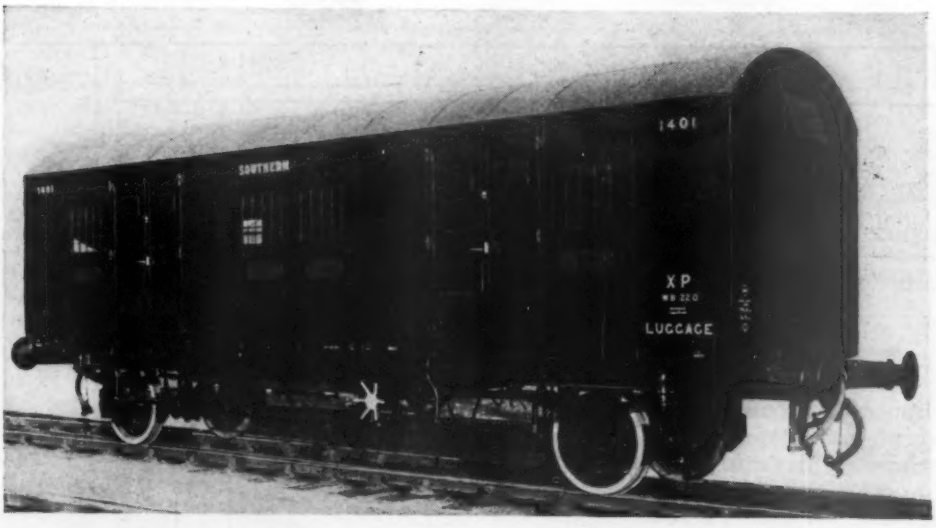
Fig. 5 gives a series of readings taken with the dryer discharge system shut off, thus showing what can occur if no steps are taken to control the carry-over into the dry pipe. As before, the test was started by increasing the rate of evaporation suddenly. The temperature of the steam leaving the No. 1 shape unit dropped to boiler saturation temperature and there was a considerable drop in the steam-pipe temperature. Both calorimeters show moisture in the dry pipe. After 9 min. the observations indicated that the carry-over decreased. This was probably due to the fact that concentration of both dissolved and suspended solids in the boiler had been reduced by the amount carried away. At 18 min. the carry-over became worse again.

The next series of tests was made with the dryer discharge system both turned on and shut off for practically continuous locomotive operation. The test was started with the discharge system shut off, and a foaming condition was created by increasing the exhaust pressure from 10 to 20 lb. per sq. in. Considerable carry-over immediately resulted. The steam-temperature and calorimeter readings show the same alternations in severity of carry-over as pointed out for Fig. 5. At 20 min. the dryer discharge system was turned on. Five minutes later both calorimeters indicated zero moisture and both steam temperatures were together at 675 deg. F. With such readings, it must be assumed that the steam in the dry pipe was practically dry. The dryer discharge valve continued to blow intermittently showing that carry-over into the dryer was still occurring. The train then went through a siding slowly but did not actually stop. After getting back to the main line, readings were continued with the dryer discharge system shut off. With 18 lb. per sq. in. exhaust pressure, the steam-temperature and calorimeter readings show a severe carry-over. At 60 min. of the test, when both steam temperatures were at the boiler saturation temperature, the dryer discharge system was turned on. The steam temperatures immediately started to increase and moistures indicated by the calorimeters approached zero. At the end of 62 min. the engine came to a stop and the test was ended.

All during these tests, the observations made through the sight glasses were interesting. At the very beginning with good water in the boiler, the surface of the water appeared relatively clear. Later, when the water was in a foaming condition, the surface of the water would usually appear to be a grayish color. When in this condition, an increase in the rate of evaporation would cause the foam level to rise and, when it approached the entrance to the dome, the steam would carry it up so that the dome would be entirely filled.

It is possible for carry-over to be sufficiently severe for the engine crew to notice it, as for the conditions illustrated in Fig. 3. Frequently, carry-over is taking place with no indications to the engine crew. Figs. 4 and 5 do not show any change in the water level that can be attributed to anything but the normal variations obtained due to track conditions and operation of the boiler feed pump. The condition of the water in the glass during these tests was good at all times. In spite of this, the readings proved that sufficient carry-over was taking place to impair the efficiency of the locomotive and, in time, to result in the failure of superheater units.

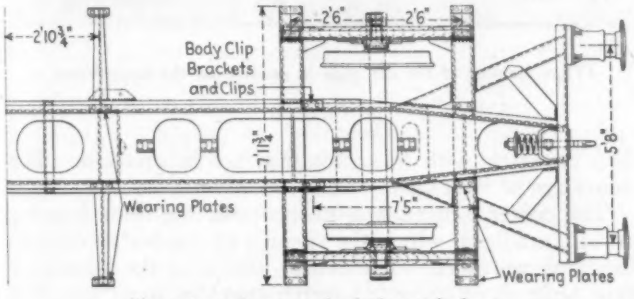
Plastics for Car Building



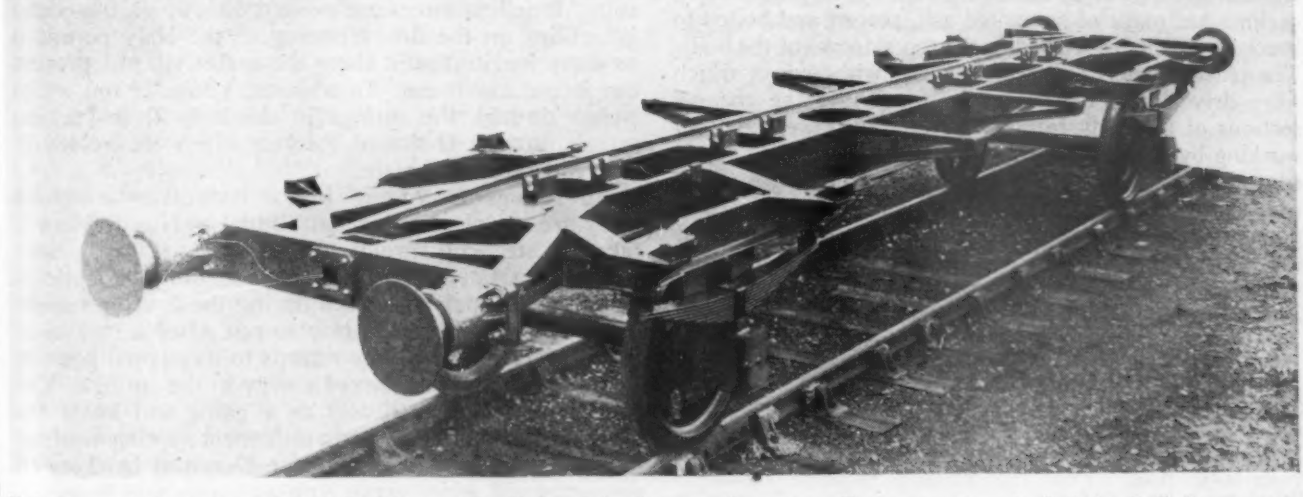
Southern Railway of England uses plastic-impregnated wire mesh for sides, ends and roofs of baggage cars – Spring cushioning of car body is an additional innovation

THE Southern Railway of England has placed in service in the past year ten four-wheel long wheel-base express cars in which the side, end and roof sheets were formed of reinforced wire mesh plastic panels. These cars also represent a departure in design in that they are spring-cushioned. The cars are used for all types of traffic and are designed to run in passenger trains at high speeds.

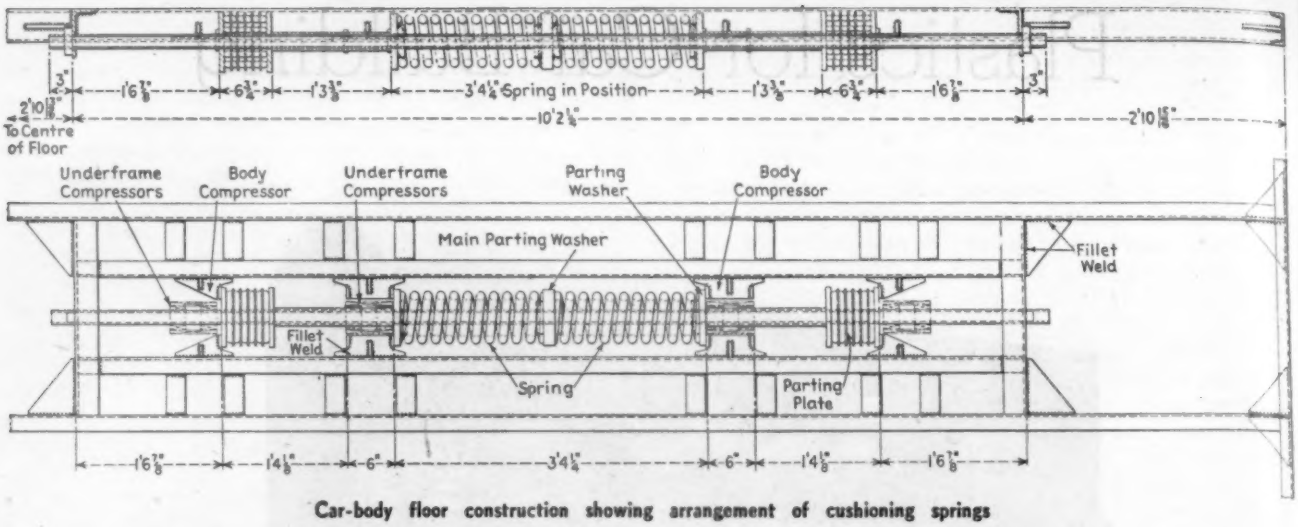
According to O. V. Bulleid, chief mechanical engineer, the following considerations were taken into account in designing the cars: reduced weight consistent with strength; avoidance of sudden shock to passengers or lading; use of new materials such as plastics where possible; following of latest methods of fabrication; and, assurance that maintenance costs would not be increased.



Plan view of one end of the underframe



Underframe of the spring-cushioned English car—The U-shaped brackets on the center sill serve as stops to limit longitudinal movement against the springs



Car-body floor construction showing arrangement of cushioning springs

Because the advances in manufacture of plastic materials have been very great in recent years, the railroad chose a form of reinforced plastic in which the reinforcement consisted of woven high-tensile steel wire and cotton mesh. The impregnating material is a phenol resin. The impregnated sheet is placed between two other sheets of ordinary impregnated material and the three layers pressed into a single sheet between steam-heated platens at a temperature of about 160 deg. C. and a pressure of one (British) ton per sq. in. War conditions dictated the use of black sheets but any color can be used. The sheets are impervious to attack by acid or atmospheric conditions, which prevents fading or other discoloration.

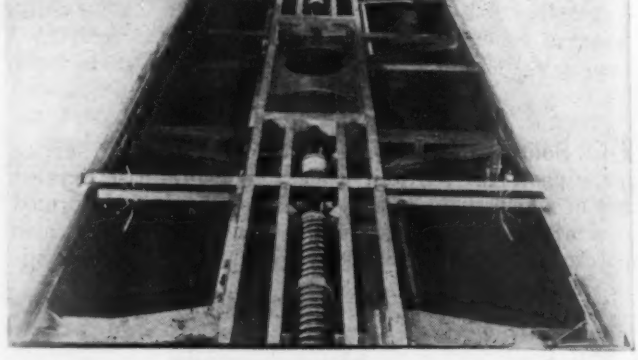
Press limitations required the use of sheets no larger than 6-ft. 6-in. by 3-ft. 3-in. and the car-body design was affected accordingly. The light weight of the material, 11½ oz. per sq. ft., was largely responsible for the adoption of the other innovation in design, spring-cushioning. Because of the lack of experience with the use of plastic structural materials it was felt desirable to protect the body and lading as much as possible from shock. A convenient way to do this was to separate the body from the main frame and introduce a form of spring-cushioning device similar to some which had been used with good results on English open-top and house-type cars.

The car body framing is generally of light channel sections, 2½ in. by 1¼ in. of 12-gauge steel, electrically welded in a jig. The floor framing of the body is of rolled channel sections with dimensions of 4 in. by 2 in. The carlines are made of laminated ash, shaped and bolted to brackets which are welded to the top side rail of the body. The plastic panels are held in place with screws which were driven into furring strips fitted into the channel sections of the body framing. They are prevented from working by a supporting strip fastened along their lower edges. Each joint is covered with a molding strip which was also screwed into the furring. A bitumastic compound was used to coat the panels and molding strips at the joints.

The sides and ends on the interior are finished with 3½-in. by ½-in. lining. The flooring is of grooved oak

General Dimensions and Weights of Baggage Car With Plastic Panels

Length over buffers, ft.-in.	36— 5
Wheelbase, ft.-in.	22— 0
Length over end sills, ft.-in.	33— 0
Length of car body, ft.-in.	32— 2⅛
Width of car body, ft.-in.	8— 2⅛
Width inside, ft.-in.	7—11
Height, rail to top of roof, ft.-in.	12— 4¹¹/₁₆
Weight of underframe, lb.	5,348
Weight of body, lb.	3,080



Floor framing of the car body in position on the underframe

1¼ in. thick with loose tongues set in creosote. The doors are of light sheet steel.

The center longitudinal members of the floor framing form a cradle in which the springs of the body cushioning gear are held. The center sill is of the cantilever type built up of plate and sections welded together. The end sills are welded to the diagonal braces and buffing shocks are transmitted through these braces to the center sill. All pulling forces are exerted directly on the center sill. Clips on the floor framing of the body permit it to move longitudinally along the center sill but prevent any lateral movement. In addition, a tubular rod which passes through the springs in the body floor framing travels through U-shaped brackets which are welded to the center sill cover plate.

All springs are carried in the body floor structure. They are arranged in tandem. Initial body movement is taken by steel coil springs. When these are partly compressed a part of the load passes to a set of rubber springs. These give a high resistance during the final movement of the body which they bring to rest after a maximum travel of 11 in. The body returns to its normal position by the exertion of the stored energy in the springs. The tubular rod mentioned acts as a guide and holds the spring assembly during body movement; spring washers on the rod make contact with the U-shaped brackets on the center sill which serve both as guides and stops.

(Continued on page 60)

Diesel Mechanical Repairs*

By P. H. Hatch†

The Diesel engines, accessories and the equipment of the locomotive itself require a well-planned maintenance system and adequate facilities

THE Diesel engine or engines of a Diesel-electric locomotive are the principal problem in considering general repairs to the mechanical portion of the locomotive. As to the detailed procedure which is best to follow for any given make of engine the manufacturers' instructions should govern, at least until methods and programs based on experience are thoroughly worked out. Regardless of the make or type of locomotive Diesel engines, however, certain general considerations have a bearing on the matter. The most important of these and the one which is fundamental is that maintenance must be on the basis of preventive attention at definite intervals of service, i.e., miles in the case of road locomotives and miles or service hours in the case of switchers.

Whether or not a given type of repair is handled all at once at extended intervals or progressively during such intervals depends on the design of the engine and the maintenance policy of the railroad. Cases in point are cylinder heads, pistons, liners, water pumps, bearings and other parts subject to unit replacement, which may be taken care of in conjunction with other repairs of a general or classified nature or done progressively during layovers or at other convenient opportunities during service. Since in either case methods employed are generally similar, it will be assumed, herein, for the sake of convenience, that all repairs are concentrated in a single, simultaneous program.

Diesel engine repairs, therefore, will be along the following lines:

(a) Remove cylinder heads, dismantle and clean; re-face valve seats or if worn to limit install new inserts or weld in new seats, preferably of specially hardened material, and grind to contour; grind valves and if stems are worn sufficiently to require attention, re-plate to original diameter or turn down to an undersize dimention and use special valve guides; renew or build up and remachine valve guides; inspect valve levers, springs, spring retainers, bushings, etc.; check gaskets, or seal surface.

(b) Remove pistons and dismantle from rods; take out and discard rings, thoroughly clean all parts and inspect for cracks and worn grooves; if grooves are worn excessively, machine for oversize rings (if a satisfactory method has been developed, machine out worn grooves, weld in replacement material and re-machine grooves to standard dimensions); install all new piston rings; inspect pins or attachments to rods.

(c) Inspect cylinder liners or sleeves and replace if necessary; remove any ridge appearing at top of ring travel; if necessary, lightly hone interior surface for quick seating of new rings; check gasket or seal surface and install all new seal rings if liner is removed.

(d) Inspect connecting rods and check for straightness and parallelism; magnaflux for detection of cracks; clean out oil passages; inspect, repair or replace big-end bearing shells, re-installing with proper clearance.

(e) Inspect, repair or replace main bearing shells and note condition of journals; check crankshaft with dial indicator at each throw for distortion; inspect each pin for condition of surface and measure for out-of-round, blow-out or clean oil passages; clean entire crankcase interior thoroughly. (If pins or journals are badly worn or are scored, it may be possible to restore them to standard conditions or dimensions by machining, metal spraying and grinding; this will, of course, involve removal of the shaft from the engine in which case detailed inspection, including magnetic test can be made. If wear or scoring has taken place to a point under the minimum allowable diameter, then the shaft must be replaced.)

(f) Inspect gear train or trains as far as possible and check for backlash; if the crankshaft must be removed, then more detailed check can be made together with necessary repairs or replacements, such work including camshaft bearings and cams, cam followers, push rods, etc.

(g) Remove and dismantle supercharger or blower for inspection, cleaning and necessary repairs; inspect blower drive and make any repairs necessary; clean air intakes and air passages, cleaning or renewing all filter elements; inspect exhaust piping and muffler and clean.

(h) If required as result of service, experience, remove, dismantle and repair lubricating oil pumps and inspect drives; remove and clean all lubricating oil piping and clean or renew filter elements on engine; renew flexible hose connections; check setting of regulating valve.

(i) Remove; dismantle and inspect water pumps and check drives; check and clean all water piping on engine and renew flexible hose connections.

(j) Remove governor; inspect drive and install reconditioned and readjusted unit; remove throttle operator; clean and repair; check all linkages; inspect overspeed shut down device.

(k) Remove all fuel injection equipment (nozzles, high pressure pumps, injectors) and install new or factory reconditioned units; check over high and low pressure piping on engine and inspect fittings and clamping; clean or renew all filter elements; inspect fuel pump drive assembly or injector cams and levers and make necessary repairs or renewals.

(l) Remove water and oil radiators, clean thoroughly and test; remove heat exchanger, clean and test; remove locomotive lubricating oil piping and clean; clean or renew locomotive filter elements; remove and clean all regulating or relief valves and adjust for proper settings; clean interior of expansion tank and paint with special mixture; clean locomotive cooling water piping.

* This is the second of three articles discussing general and running repair facilities for Diesel locomotives. The third will appear in a subsequent issue.

† General mechanical superintendent, New York, New Haven & Hartford, New Haven, Conn.

(m) Inspect and make necessary repairs to radiator fan and drive, including pulleys, idlers, belts, gear box, angle drive and fan; inspect radiator, shutters, operating mechanisms, etc., clean fan; fan housing, shutters, etc., to remove surface dirt.

(n) Remove, inspect, clean and calibrate all indicating or contact making gauges including fuel and water tank level indicators.

(o) Inspect fuel transfer pump and motor and make necessary repairs or replace with reconditioned unit; clean and adjust pressure regulating valve; clean or renew all strainer elements.

(p) Drain fuel tank, flush and clean.

(q) Reassemble engine restoring clearances and fits to manufacturer's tolerances and standards as closely as possible. It is not good practice to be economical with gaskets or seals—install new wherever disturbed or where it is known deterioration takes place. Tighten but do not over-tighten bolts and nuts and check them for tightness after the engine has been run for a while. Use new or reclaimed crankcan oil. Run in thoroughly and load test as described later.

From the outline just given, one fact is of immediate importance from the standpoint of shop schedule and production. This is the beneficial result to be obtained from a stock of complete spare units of Diesel engine equipment to replace similar units coming in on an engine and which will require repairs or reconditioning. This serves the double purpose (1) of preventing delay in reassembly of an engine while waiting for repairs to be completed on individual parts and (2) of allowing the different classes of repairs to be segregated and handled by specialized groups in the shop. This, in turn, permits quantity production methods to be employed as far as possible, depending on the total number of locomotives involved. For example, one gang can be assigned all cylinder head work and making use of spares, can have a completely reconditioned set of heads ready the minute each engine is at the point where heads are required. The heads which were removed from the engine can be given the necessary attention and made ready for the next assembly and so on. If by any chance more than normal repairs are required on any head or a set of heads, these can be handled without delaying the engine, on which they came in. Applying this same procedure to fuel injection equipment, governors, pistons and rods, etc., all important categories of parts of Diesel engines can be handled in the quickest possible time which will be reflected in less out-of-service time for the locomotive and less over all cost of maintenance.

It can readily be seen that if this method is adopted, it will not be long before no engine will have its own quota of original parts. This imposes a duty on the part of the shop to keep complete and accurate records of all change-outs, which in turn, requires serializing of all interchangeable parts. This will not present any serious problem, for the application of serial numbers is standard practice with the manufacturers and in those cases where serial numbers may not have been applied it is easy for the railroad to do so.

Some railroads engaged in the intensive use of a considerable number of Diesel-electric locomotives have gone so far as to purchase complete spare Diesel engine generator sets to permit lifting out power plants in for repairs and replacing them with complete reconditioned sets. While this may be rather expensive in first cost, it pays the maximum in benefits because very considerable time saving for the entire locomotive results and engine rebuilding can be handled most efficiently. It also offers a high degree of protection in cases of casualties in service requiring engine rebuilding.

In concluding the remarks on Diesel engine repairs, one fact cannot be over-stressed. This is adequate running in and breaking in before releasing for service. Time, fuel and labor spent in this will be amply repaid. Combined with this should be determination of compression and ignition pressures in each cylinder, exhaust gas temperature for each and the noting of engine speeds, lubricating oil pressures and temperatures, cooling water temperatures, supercharger or blower pressures, horsepower output under varying conditions of current and voltage, as indicated by the main generator characteristic curve, individual notch speeds and loading, color and quality of exhaust, general sound and action of the engine under load and acceleration, and so on. The facilities for this have already been listed and include a water rheostat or resistor bank for loading, cylinder pressure indicator either of the maximum instantaneous pressure or the curve drawing type, pyrometer and thermocouples, voltmeter and ammeter with shunt and the usual complement of pressure gauges, thermometers and temperature indicators which are a part of the regular engine equipment.

Preparatory to applying full load to an engine the following procedure has been found to be satisfactory in the case of one make and type of Diesel engine:

(a) After first starting the engine and while idling to determine that conditions are normal in all respects including proper connecting rod and main bearing temperatures, idle for eight hours if main bearings have not been disturbed or for 16 hours if the main bearings have been removed or replaced. General watch should be kept of the engine during this time and checks of bearing conditions should be made at increasing intervals during the eight or 16 hours.

(b) After the idling is completed, load the engine to the proper degree and run for 35 min. in each notch until the highest is reached, after which the full load testing can be completed in accordance with requirements.

(c) After the load testing is completed, check over all accessible bolts and nuts on the engine for tightness and change crackcase oil.

When considering the mechanical parts of the locomotive, the one next related to the Diesel engine is the air compressor. On the majority of locomotives this is usually belt driven from the Diesel engine or it may be mounted on the engine and direct connected to it. In any event, Diesel engine repairs of the type described should be accompanied by similar repairs to the air compressor which will consist principally of thorough cleaning, reringing of high- and low-pressure pistons, renewal of valves including unloader valves, etc. Bearings should, of course, be inspected and replaced if necessary; unless bearing trouble has been experienced the crankshaft will require little or no attention for extended periods.

If the locomotive is equipped with train heating boiler either it should be replaced with a re-conditioned unit or it should be given attention to put it in first-class shape for the next period of operation. Such attention will consist in general of removal of coils for cleaning, testing and replacement if necessary; the burner element should be removed and reconditioned and the firebox section renewed; the steam separator and water treatment tank should be cleaned; such items of auxiliary equipment as the main driving motor, fan, belts, feedwater pump, fuel pump and the various control switches, relays, protective devices, etc., should be removed for cleaning, repairs, calibration or adjustment or replaced with

(*Continued on page 65*)

OVER THE HILL WITH A DIESEL

By Walt Wyre

Part 1

NED SPARKS, electrician for the S. P. & W. at Plainville, walked the length of the powerful four-unit Diesel electric freight locomotive that stood on the full track about two hundred yards from the roundhouse. Resplendent with its bright colors and decorative stripes, the 5400 horsepower locomotive stood alone as though disdaining to associate with the steam locomotives being serviced in the roundhouse.

"Pretty, isn't she?" Jim Evans, the roundhouse foreman, remarked to Sparks.

"Sure is," Sparks agreed, "and pretty isn't all. I'll bet she can make passenger train time with a hundred loads from here to Sanford."

"That's right," Evans cocked his head to one side and eyed the locomotive, "but I wonder how she will perform on the Mountain Division."

"Why, I thought they were going to use the Diesels on the Plains Division!" Sparks said.

"They are," Evans nodded, "but the present plan calls for running them over the Mountain Division, too. They are to run from here to Sanford, then over the Mountain Division by way of Hillside to Altus and return."

"Lots of sharp curves and tunnels on that route," Sparks commented. "Wonder how many cars a Diesel will handle up the hill from Altus to Hillside?"

While the two were pondering the problem, H. H. Carter, the master mechanic, accompanied by road foreman Tom Price and a stranger, came up. Carter introduced the stranger to Evans and Sparks as Wallace, an expert from the Diesel-electric factory.

Wallace shook hands. "My first name is Sam," he said. "That's what everybody calls me and I haven't got time to get accustomed being called Mister."

"Glad to know you, Sam. Sometime when you are not too busy, I would like to ask a lot of questions about Diesel-electrics."

Sparks started to leave when the master mechanic stopped him. "Just a minute, Sparks. You may have a chance to learn about freight Diesels sooner than you think."

"I understand you have had considerable experience on passenger Diesels," Sam said.

"Oh, not a lot," Sparks replied. "I have done some work on them."

"How would you like to be a traveling Diesel electric maintainer?" Carter asked. Then before Sparks could reply, the master mechanic added, "You see, we plan to put maintainers on the freight locomotives, perhaps temporarily, maybe permanently, that remains to be determined. The jobs will be bulletined. In the meantime if you are to start breaking in on it you can go out tomorrow. Mr. Wallace will be with you to explain anything you don't understand and tell you what to do."

"O. K.," Sparks agreed, "I would like to try it a while, anyway."

"We may have quite a few 'bugs' to work out on the first trip," Wallace said. "Hope they don't hang too much train on going up the hill."

"What time will we get out?" Sparks asked.

"Sometime around six or seven o'clock in the morning," Carter replied. "I'll tell the engine dispatcher to call you when he calls the engine crew."

SPARKS was sleeping peacefully when the phone rang at 5:30 next morning. He reached for the alarm clock to shut it off. His wife nudged him in the ribs with her elbow. "The phone is ringing," she said.

"Uh-huh," Sparks mumbled, and turned over.

"Go answer the phone," Mrs. Sparks nudged again and harder.

"Wonder who is calling this time of night," Sparks growled. Then he remembered.

"Called for 7:00, extra 900 west," the dispatcher said. Sparks repeated the call and replaced the receiver.

Wallace was waiting at the roundhouse when Sparks arrived about six-thirty. "Better check the oil, water, and fuel," Wallace suggested, "I'm certain it was supplied yesterday, but it's a good idea to get into the habit of checking. While you are doing that, I'll start the engines and let them be warming up."

The engineer, Ed Holcomb, had run passenger Diesels; the fireman, Dan Walters, was new on the job. "What am I supposed to do?" he asked Wallace.

"Watch the engine temperature and keep it as near 165 degrees as you can," Wallace told him. "While the engineer is waiting for orders, I'll show you about handling the fans and shutters to regulate the temperature."

Sparks, who had finished checking the supplies and had come into the cab, followed Wallace and the fireman into the engine room.

"It's fairly warm this morning and I have an idea it's going to get really hot in about three hours, so you will need both fans in, and my guess is two shutters about half open to start. You can see the temperature is only 135 now," Wallace pointed to the gauge on the water tank, "and we will leave the fans out and shutters closed until the engineer couples on the train. By that time I have an idea the temperature will be up around 160. It's not a good idea to work the engines very hard when they are any cooler than that and, as I said before, around 165 degrees is best."

The engineer interrupted the conversation with two short toots of the whistle. "You and Sparks kick the fans in like this,"—Wallace placed his foot on the clutch lever and shoved gradually—"and don't ever put the clutch in with the engine running faster than idling," he cautioned.

The electrician and the fireman started through the engine rooms. Wallace stepped up into the cab and told the hogger that when all fans were in he would signal by ringing the attendant's call bell twice. He then turned and followed the electrician and fireman, checking lubricating oil, pressure gauges, and fuel oil sight glasses as he went.

They found a train of eighty-seven loads waiting on No. 5 track. By the time the air test was made the engine temperature had climbed to almost 160 degrees.

"Is there a stretch of level or down-grade between here and Sanford?" Wallace asked the engineer.

"Yes," the hogger replied, "right after we cross Clear Creek it's uphill about six miles, then the only up-grade for the next thirty miles is this side of Middleton and doesn't amount to much."

"Well, I guess we can cut an engine out along there," Wallace said to Sparks, "and I'll show you about making an inspection—inspecting crank case mechanism, cleaning and inspecting the air box and inspecting valve and injector rack mechanism; also, the timing will be part of the maintainer's job," Wallace explained. "You see, that will materially reduce terminal time required for inspecting and servicing."

"What about electrical inspection?" Sparks asked.

"Oh, yes, we have a regular routine worked out. The Diesel supervisor has been working with us several weeks." Wallace pulled a long mimeographed sheet from his pocket. "You see, the ones marked with an X will be done by maintainers. Take this and look it over."

"High ball!" the hogger said as he acknowledged the conductor's signal to start.

"Don't be in too much rush about starting," Wallace cautioned the engineer, "unless you want to pull out a drawbar. Give the air plenty of time to release."

The powerful locomotive started the train with little effort and it was soon rolling out the lead to the main line. The engineer held the speed down to fifteen miles an hour until the train was on the main track, then began to notch the throttle back.

"Now let's go through and see if all of the contacts are closing and engines loading properly," Wallace said to Sparks. "Better check temperatures," he advised the fireman.

Everything was O.K. until Sparks and Wallace reached the No. 3 unit. The throttle was in the eighth position but the load indicator was only on the sixth. Wallace pointed and yelling in Spark's ear called his attention to the discrepancy. Sparks saw the indicator but the roar of the Diesel drowned the words.

Wallace went to the high voltage cabinet, Sparks following. The engineer was operating with the transition lever in No. 2 position (series-parallel-shunt). The motor field shunting contactors on that unit were not closing. Wallace found a flag stick with which he pushed lightly on the series contactor interlocks. The "M" contactors closed and the load indicator climbed to eight. The two men walked to the rear cab.

"It's always a good idea to check all contactors and engine loading when leaving the terminal," Wallace explained to Sparks. "We'll clean that interlock with a piece of crocus cloth soon as we get a chance to take the engine off the line and kill it. Don't start poking your fingers around the contactors when the engine is running; might get one burned off," he added.

They sat in the cab and talked a few minutes, Wallace explaining operation of the transition meter and its relation to the various speeds. "The transition meter is simply an ammeter," he pointed out, "and instead of being calibrated in amperes, is marked off to show shifting positions. Makes it more simple for engineers to understand. You might take a walk through the engine rooms and see how everything looks," he added.

When Sparks started to look at the engines the train was on a slight down grade towards Clear Creek bottom. In a few minutes he returned. "Say, none of the load indicators show as high as the throttle indicator."

Wallace glanced at the speed indicator, then at the transition meter before replying. "That's O.K. However, it wouldn't hurt for the engineer to close the throttle a couple of notches. You see, the load regulator has reduced the main generator field, thus cutting down the load on the engines."

Going through Clear Creek bottom they ran into a rain, not heavy, but enough to wet everything. There was a twenty-mile-an-hour slow order over the bridge and a fairly steep grade coming up out of the bottom. Approaching the bridge, the engineer closed the throttle and made an application with the automatic brake valve. Evidently the hogger put more air under the train than he had intended. By the time the caboose reached the bridge, speed had dropped to between 10 and 12 m.p.h.

"He may have a little trouble if the grade is heavy as I think," Wallace observed as he watched the speed indicator.

The transition meter needle swung to the right, showing increased traction motor current. The wheel slip indicator light flashed on and off a couple of times. Gradually the speed increased until the train was going about fifteen miles an hour. The wheel slip indicator light flashed on several times, the train started losing speed. Wallace rose from his seat to start towards the front end of the engine. Just as he reached for the door latch, the alarm bell started ringing.

"I was afraid of that," Wallace said. "An overspeed trip has operated and killed an engine. Let's see which one it is." He started through the engine rooms closely followed by Sparks. "Here it is," Wallace announced as they entered the engine room of the No. 2 unit.

Sparks watched as Wallace latched the overspeed trip, then turned the isolation switch to start position, cutting the engine off the line, and pressed the starting button. When the engine had started, Sparks reached for the handle of the isolation switch.

"No!" Wallace caught Sparks by the arm, then took hold of the lay shaft lever. "Now throw it on the line." Wallace held the lay shaft lever and allowed the engine to pick up speed gradually until it was carrying a full share of the load, then released the lever and went to the front engine room. They met the fireman who hearing the bell was looking for a hot engine.

"Seems like she's not pulling so well," the engineer said when Wallace and Sparks entered the cab.

"It's doing O.K. now," Wallace replied. "The No. 2 engine slipped her wheels and the overspeed trip kicked out. Just take it easy, let her pick up gradually. Slip a little sand under her—not much."

"How did you know it was an overspeed trip?" Sparks asked.

"Well, the circumstances indicated that to be the trouble. The engines working full throttle and slipping occasionally, that's what usually causes an overspeed trip to operate."

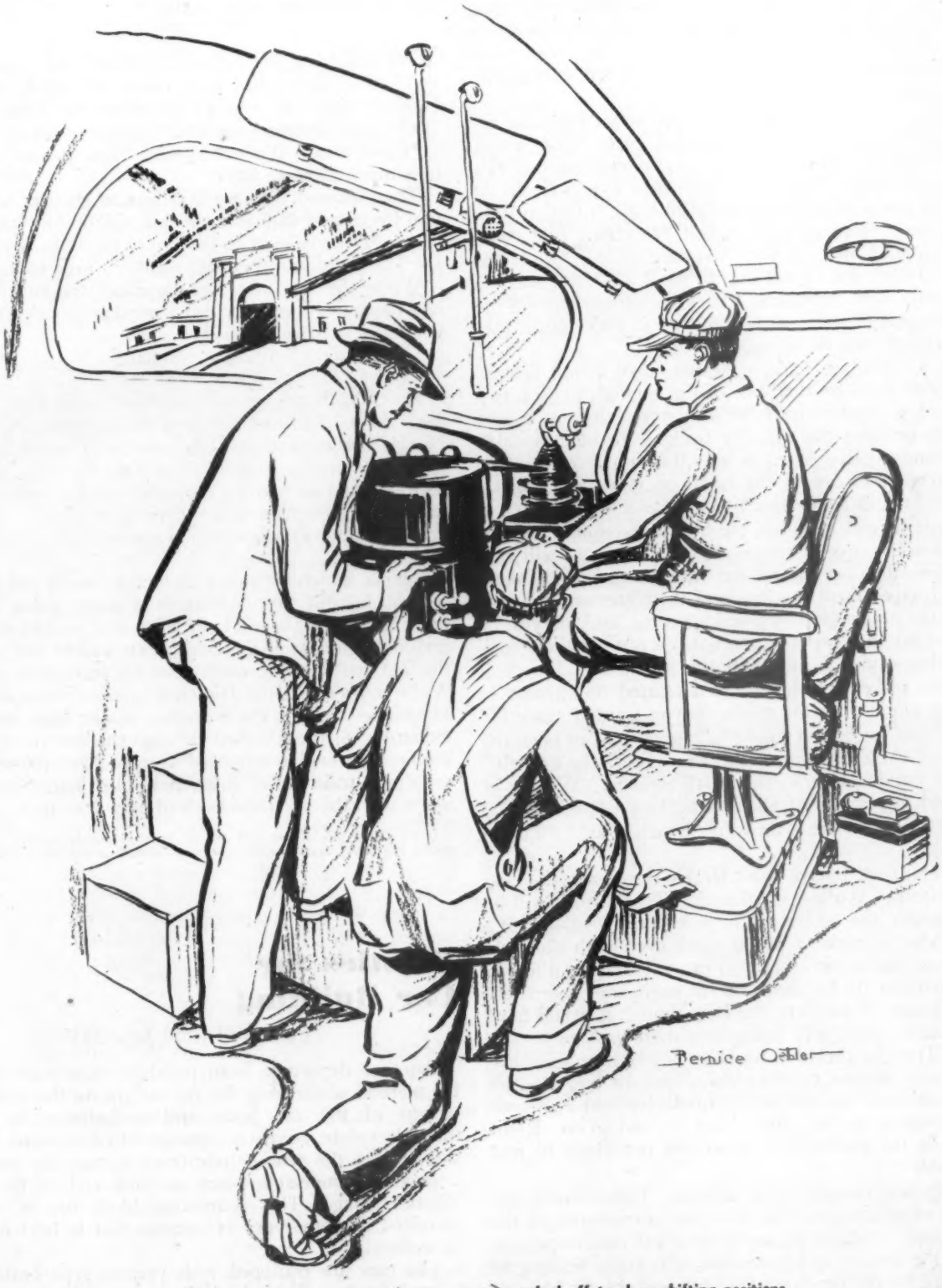
They had no more trouble going up the hill and would have had none in the first place if the engineer had not tried to pick up speed too rapidly on the slick rails. By

the time the train topped the grade it was rolling along nearly twenty miles an hour and picking up all the time. There was a slight up-grade about two miles more, then the level stretch that the hogger had mentioned.

Wallace and Sparks rode the front cab until they were almost to the level track, then Wallace said, "Guess we might as well make an inspection on the rear unit. It won't take long with two of us doing it."

The two men went to the tool cabinet in No. 2 unit. "What tools will we need?" Sparks asked.

"Well, about all is a wrench to fit the inspection plate nuts," Wallace told him. "When we get back to Plainville, I'll have a bar made and an eye bolt welded to the floor in each engine room so we can use a Coffing hoist to turn the engine. One man alone can't get along very well barring the engine over by hand and it's almost im-



The transition meter is simply an ammeter marked off to show shifting positions

possible to check injector and exhaust valve timing that way. These are the gauges to check timing,"—Wallace picked up a small box and handed to Sparks who opened the box and saw a thickness gauge which was just a flat piece of polished steel and a short polished rod, one end turned smaller with a shoulder. "Bring them along, I'll show you how they are used."

"Want to kill the engine now?" Sparks asked when they had walked to the rear unit.

"Not yet," Wallace said. "Let's lift the covers off the top and look at the upper mechanism while it's running. Take her off the line first," Wallace cautioned. "You might get an oil bath if you don't. Put the isolation switch in start position, then in case the engineer opens the throttle it won't affect this engine, it will continue to run at idle."

Wallace lifted a section of the top cover from the engine and hung it on an inspection plate hand wheel. Sparks did the same until the four covers on one side were removed. "Now let's look them over. Look for loose oil pipes, loose crab nuts, head bolts, injection leakage, broken valve springs, in fact everything that could cause trouble, and, oh yes," Wallace added, "while the covers are off, it's a good idea to see if the lower exhaust stack bolts need tightening. They sometimes work loose from expansion and contraction, then if they get to leaking a gasket may be blown out."

Just as Wallace had suggested, they found several stack bolts loose on that side of the engine. In fact, two nuts had worked entirely off and were lying on top of the web between the cylinder banks. No other trouble was found on that side. It was the same on the other side except that one of the small oil pipes was slightly loose and might have caused trouble later on.

"Now we will make an air box inspection," Wallace said when the covers were replaced. "First, we will stop the engine then remove all the inspection plates. Take a rag and wipe oil off the inside of the plates and the bottom of the hole so it won't make a mess, and, oh yes, be sure and lay the covers in order so we can put them back where they came off, otherwise they might leak."

Sparks picked up the bar and started to attempt to turn the engine. "How much do you want it turned?"

"Not any yet, and it might be a good idea to open the relief cocks before you try to turn it. Here's the wrench." Wallace handed Sparks the small wrench. "Now," he explained, "let's look at all pistons. Got a flashlight?"

"Left mine in the rear cab," Sparks said. "I'll go get it."

"Never mind, I have one. Here's the idea of looking at all pistons," Wallace continued. "Two pistons will be on top center, the others will be in various positions. It's a good idea to make a pencil mark even with the ones that are on top center, then you can tell when you finish. Now we'll take the bar and turn the engine approximately 22½ degrees. If we were checking timing, it would have to be exact. That will bring two more pistons to top center. Then by the time we have finished we will have seen tops of pistons, cylinder walls, and the length of all pistons, at least on one side. Look for water, scored liners, stuck or broken rings, blow-by, and so on. Right now while the engine is new we are not likely to find any trouble."

Wallace was correct in his surmise. There wasn't any evidence of trouble and the fact was so indicated on the work report. They didn't make the crank case inspection because the train was approaching the grade leading in to Sanford by the time they had finished the air box inspection and replaced the covers. However, Wallace explained how it was done and to look for loose nuts, inspect bearings, see that piston cooling oil pipes were in proper position, and so on.

When the engine was started, Sparks started to put it on the line as he had when the one had died. "Wait until the oil pressure builds up. How's the water temperature?"

"It's down a little below 160," Sparks replied.

"That'll be O. K.," Wallace said. "It will be warm by the time the engineer needs to work it hard. Don't ever let them work too cold. If you do, you are headed for trouble, especially water leaks."

THE run from Plainville to Sanford had been made in good time. They had only taken one siding to let the Limited pass. It was 11:50 when the train stopped. "Let's eat," Sparks suggested.

"Good idea," Wallace agreed, "but first let's find out how much time we have."

They learned that the 900 was to go over the mountain by way of Hillside and pull a 3200-ton train with a steam Mallet helping to the top of the hill. It was called for 1:35 P.M., so they had plenty of time to eat.

While the two men were waiting, the call boy came into the eating house, looked around and came over. "Are you Sam Wallace?" the boy asked.

"That's right," Wallace nodded.

The boy handed him a message.

"Do you think you can get over the hill O.K. without me?" Sam asked when he read the message. "Two more Diesels are coming in today and they want me to go back to Plainville tonight. You'll do all right." Wallace laid his hand on Sparks' arm. "Guess I'd better eat in a hurry, the passenger is due here right now."

The train was a few minutes late which allowed Sam time to finish.

Sparks somehow wasn't as hungry as he had been before he learned that he was to be alone going over the hill. He drank a second cup of coffee, pushed the soggy pudding aside, paid the clerk, then walked out to where the 900 was standing waiting for the train to be made up. As he approached the Diesel, it seemed strangely silent. He walked faster. There was no smoke from any of the exhausts. Sparks climbed through the door into the No. 2 unit. The engine was dead as were all of the rest. The passenger train tooted twice and pulled out. Sparks was alone with the big Diesel—dead as a door nail.

[Part II of this article will tell of Sparks' trouble getting started and taking the heavy train through the tunnels and up the hill.—Editor.]

Plastics for Car Building

(*Continued from page 54*)

Another departure from usual practice was made in the method of carrying the car weight on the axle. The weight of the car body and underframe is passed through volute auxiliary springs fitted in cups on the side sills to the semi-elliptic truck springs by means of a separate connecting block at each end of the semi-elliptic spring. This connecting block fits in recesses provided in both types of springs and is held in place by collars.

The cars are equipped with vacuum-type brakes and a hand brake. The wheel diameter is 37 in. and the journals 4¼ in. by 9 in.

Fireboxes and Staybolts

[THE two papers of which abstracts follow were prepared by the authors as members of the 1944 committee of the Master Boiler Makers' Association which engaged in the study of the application of staybolts and the service obtained from various methods, styles and materials. The report of this committee appeared in the November, 1944, issue of the *Railway Mechanical Engineer*, page 502.—EDITOR.]

Locomotive Firebox Failures

By D. R. CARSE

Climax Molybdenum Company

Firebox sheets fail from three principal causes: cracking on both the fire side and water side, corrugations and overheating, and corrosion. Probably the chief cause of firecracking is the effect of decarburization on the surface of the firebox sheets, where the stresses are highest (see Fig. 1). This decarburized skin has a lowered tensile strength which may drop to as little as 10,000 lb. per sq. in. at the operating temperature, and certainly does not exceed 25,000 lb. per sq. in. When the sheet is heated, the fire-side surface is placed in compression and must upset since it expands more than the interior of the sheet which is cooled by the water. Correspondingly, on cooling, this fire-side skin is placed in tension. Repetitions of this stress cycle may develop stresses in excess of the tensile strength of the decarburized surface, and hence cause cracks. The condition is further accentuated by the aging effect in certain steels resulting in lowered ductility in the interior of the sheets. This constitutes one of the principal arguments against rimmed steel, since it is always lower in carbon near the surface. Data on 50 locomotives, 25 of which had rimmed steel fireboxes while the other 25 were equipped with plain carbon killed steel, shows that all had approximately the same firebox life. It must be remembered that decarburization is usually present on all hot rolled sheets, yet all firebox sheets do not firecrack; the low tensile properties of the decarburized surface layer are simply less resistant to the stress cycle that produces firecracking. Cracks will not develop from this condition, however, unless the operating conditions are severe enough to develop stresses in excess of the strength of the surface layer.

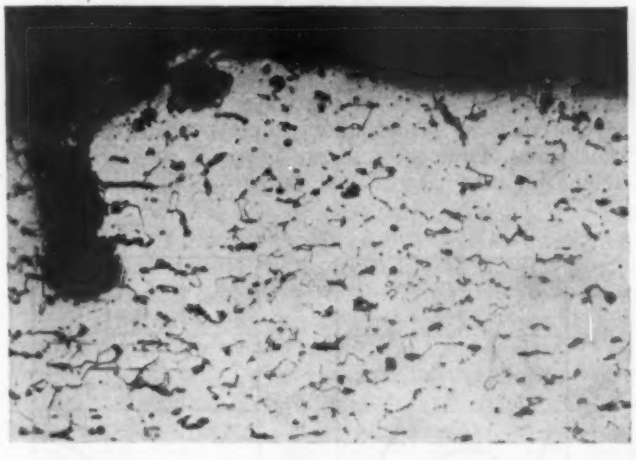


Fig. 1—Decarburization of fire-side surface of A.A.R. firebox steel (Magnification 250)

In this connection, definite issue is taken with the statement appearing in the 1943 Proceedings of the Master Boiler Makers' Association that "there is no record of an instance of sheets cracked on the fire side in the absence of leaky staybolts." Nor does a study of the subject bear out the theory advanced in that paper, that firecracking may be caused by a type of stress corrosion. There are many well substantiated instances where firecracks occur, with no evidence of any staybolt leaks whatsoever, and there are also cases of leaks caused entirely by a water condition and where no cracking occurred.

It has always been observed that firecracks follow the stress pattern and are concentrated around the staybolts, because these form the points of localized stress. Fig. 2 illustrates this clearly. The depth or rate of propagation of the cracks becomes greater as the stress pattern is intensified, and from Fig. 3 it will be seen that the depth is greatest at the point of restraint, which is that adjacent to the staybolt.

The action of the boiler water resulting from a leaky condition can accelerate the propagation of existing cracks through corrosion. This action occurs, however, only within the stress pattern. Leaking is not a direct cause of cracking, but an accompanying or secondary factor which may, or may not, occur coincident with it.

In exception to this contention, an eastern railroad cites two locomotives, one of which received special care in the staybolt installation, and the other of which was equipped with seal-welded staybolts. These locomotives had run approximately 100,000 and 75,000 miles respectively when reported upon and showed no leaky bolts

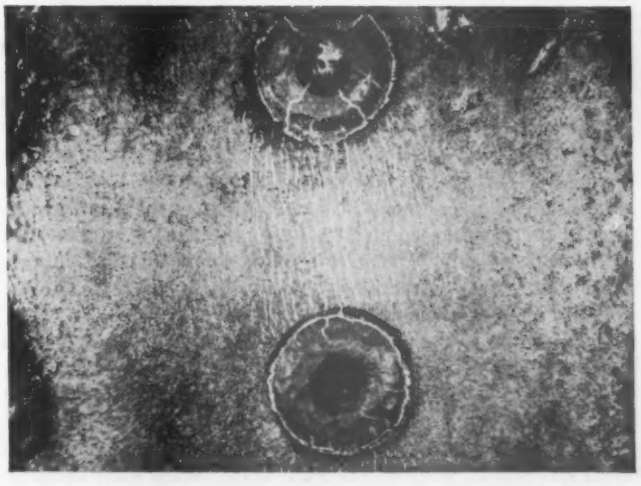


Fig. 2—Typical cracks around staybolts

Fig. 3—Firecracks increase in depth as they approach staybolts

or firecracks. Other engines of the same type in the same service developed leaks after a much shorter life, and had to be returned to the shop for complete renewal of side sheets due to firecracking. The engineer of tests of this road reasonably asks, "The question is why did not all of these similar engines in similar service act the same way and sheets consistently crack or not crack. All we definitely know, is that the engines which have not had

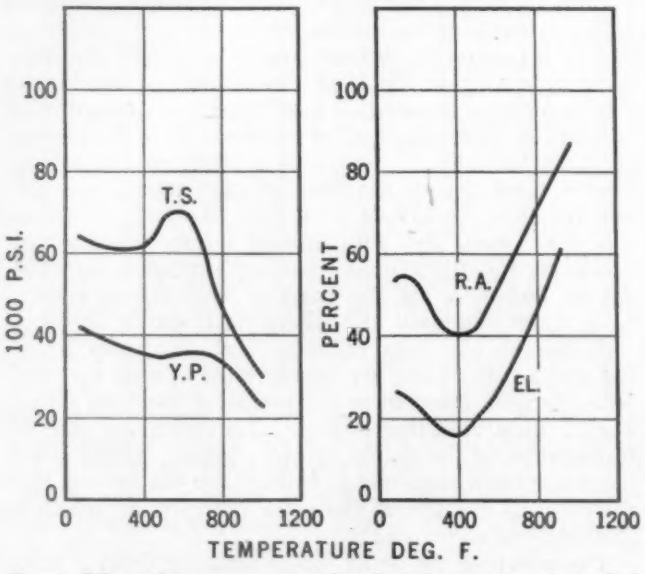


Fig. 4—Effect of temperature on the physical properties of standard firebox steel

leaky bolts have not cracked, and those which have leaked, developed cracks very quickly."

Should the experience on these locomotives be substantiated by other tests on seal welded stays where leaks are impossible, corrosion fatigue can be established as another cause of firecracking. The question is not whether leaks accelerate firecracking but whether they are the cause, since if cracks do not exist their progression cannot be accelerated. That laboratory investigation of fire-cracked sheets has at times shown no indication of any previous leakage, supports the author's original contention that leaks do not initiate cracks, but merely hasten their growth once started. The writer urges that a larger number of locomotives be equipped with plain carbon firebox sheets and plain carbon-steel or wrought-iron seal-welded staybolts, and that for these tests, locomotives be selected which are known to be subject to severe firecracking. This alone will determine whether seal welding is the answer to firecracking. The suggestion that both seal welding and alloy stays be employed defeats itself, for if the expense of seal welding is resorted to, there would be no need to use alloy.

R. Rennie of the American Locomotive Company also takes exception, and advances the theory that firecracks, at least in certain locomotives, may be attributed to sulphur contamination from the fuel. It is true that sulphur conditions are corrosive. If the surface of the steel has strain lines or stressed areas, then such lines or areas will be strain-corrosion etched. The net result would be acceleration of the typical cracking encountered, with sulphur acting as the accelerator, but not as the initial cause.

Metallurgical Approach

The metallurgical approach to the problem of firecracking is, consequently, to select an analysis containing an element which will strengthen the decarburized material, particularly at elevated temperatures. Molybdenum meets the needs in such service. Service tests over a period of many years have shown a life in carbon-molybdenum firebox sheet of roughly three times that of a plain carbon sheet before firecracking develops to a point which necessitates replacement when all other factors are equal.

A. S. T. M. Specification A 204-42 covering a steel containing approximately 0.50 per cent molybdenum, is generally used for this purpose. Even though decarburized to a carbon content of only 0.03 per cent, this analysis would still have a tensile strength at operating temperature nearly twice that of standard firebox sheet decarburized to the same extent.

Tests conducted by the Battelle Memorial Institute clearly show the unique effect of molybdenum in maintaining the strength of ferrite at elevated temperatures in wrought irons. Figs. 6 and 7 give the results of these tests. At 1,000 deg. F. a wrought iron containing 0.50 per cent molybdenum with a 0.03 carbon content loses less than 37 per cent of its room temperature strength, whereas without molybdenum, a wrought iron of 0.04 per cent carbon content at the same temperature, loses more than 62 per cent of its room-temperature strength. A similar strengthening effect occurs when molybdenum is added to low-carbon steel. It should, however, be stressed that the use of any alloying element will not eliminate failures due to poor workmanship, faulty material, or sheets improperly rolled so that they lack good surface condition.

Cracking of sheets on the water side may be due to several factors. Chief among these probably is thermal shock, one of the most severe forms of which is caused by the impingement of cold water on hot sheets. This

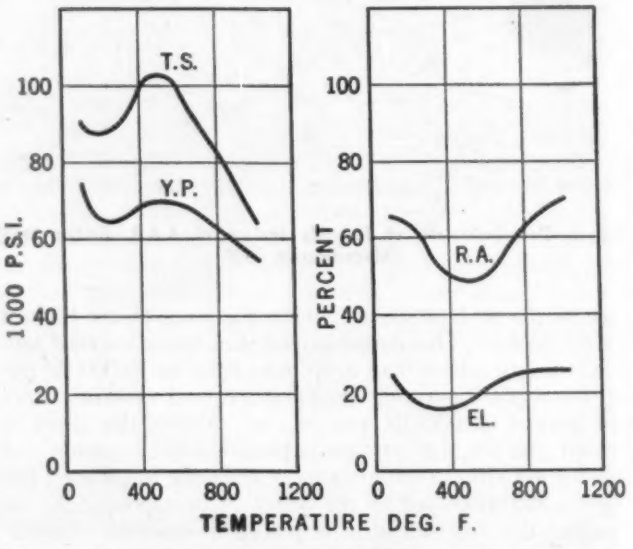


Fig. 5—Effect of temperature on the physical properties of a carbon-molybdenum firebox steel

may only be avoided by preheating all wash-out water and educating the crews to use the injector instead of the water pump when putting water in the boiler while the locomotive is standing still or drifting. Under these two circumstances, a pump should never be used unless it is equipped with a live-steam feed-water heating arrangement, or unless the boiler has a top boiler check equipped with a spray valve so as to avoid slugs or layers of cold water circulating back to the firebox. Another form of thermal shock may be avoided by stressing the

importance of firing up and blowing down boilers slowly.

A second cause of water-side cracking is stress corrosion, where localized areas of high strain are attacked by boiler water, or by entrained gases, such as oxygen or carbon-dioxide. The use of proper inhibitors seems to be the remedy for this condition. Corrosion also may

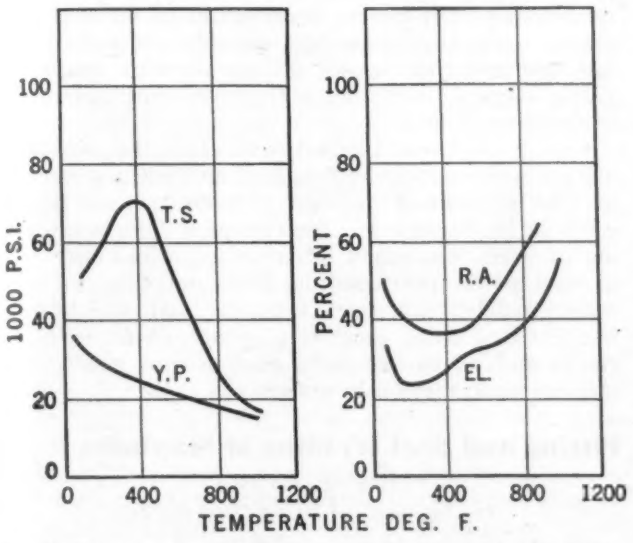


Fig. 6—Effect of temperature on the physical properties of double-refined wrought iron

occur from the use of dissimilar metals in fire-box construction.

Corrugated Sheets

Corrugation of sheets is another major cause for removal, and also the cause of many staybolt leaks. In some instances, pronounced corrugations on new sheets have forced their removal after an extremely brief service life, in order to avoid the danger of mud and scale accumulating in the depressions, and thus causing overheating. Corrugating is always an evidence of insufficient strength at the operating temperatures encountered. These operating temperatures are greatly influenced by design. Localized hot spots resulting from a circulation lag may be cited as an extreme case. Scale formation, mud deposits, or an oil film, also are frequent causes of an increase in operating temperatures, and in some instances intense heat may be localized in an area due to the location of the burners in an oil-fired locomotive or the drafting in a coal-fired engine. Low water may be included as an occasional cause of over-heating. An example of the effect of design in overheating is found in a study of the early failure of side sheets on a new Mallet-type locomotive after seven months' service. The affected area was confined to 30 sq. in. under the arch. Reported metallographic examinations showed that the steel had been heated to 1,600 deg. F. on the fire-side surface, and since no scale or oil films were present, such overheating must have occurred from a circulation lag.

The velocity of the circulation of water is of equal importance to the velocity of the gases on the heating surface. If the scrubbing action of the water circulation is insufficient to remove the steam bubbles from the heating surface as they form, the layer of steam will act as an insulating blanket that reduces the rate at which heat is absorbed from the firebox sheet.

Other investigations in the study of firebox steel failures have shown similar evidence of hot spots the locations of which depended on design.

All of the above causes of overheating drastically reduce the physical properties of plain carbon steel and the remedy can lie not only in correcting the underlying causes but in selecting a steel which has a higher factor of safety at elevated operating temperatures and which thus resists corrugation. Some railroads have endeavored to overcome corrugating by using a thicker firebox sheet. Almost invariably the slower heat transfer through these heavier sections has raised the temperature of the fire-side of the sheets to a point where fire-cracking occurred. The answer, therefore, is the use of the thinnest sheet which design considerations will permit, and the selection of an alloy steel the strength of which at temperature accomplishes the resistance to corrugation only otherwise obtainable by the use of a thicker plain carbon sheet.

Exception has been taken by Mr. Rennie to the above conclusions, on the ground that corrugations resulting from poor operating or maintenance conditions, "defy the curative power of any metallurgical technique." The writer, however, must disagree, in view of actual service records. As an illustration of the value of high strength at temperature, an extreme case reported by Ray McBrian, engineer standards and research, D. & R. G. W., might be cited of a crown sheet that failed at 1,350 deg. F. resulting in a boiler explosion. At 1,385 deg. F. the crown-sheet material (A. A. R. carbon firebox steel) had a tensile strength of about one-ninth of its room temperature strength, or 5,600 lb. per sq. in. Carbon-molybdenum firebox steel at this same temperature has a tensile strength of some 13,400 lb. per sq. in. Unfortunately 5,600 lb. per sq. in. tensile was 2,400 lb. per sq. in. lower than the working stress at that temperature, and the boiler pressure alone was sufficient to cause a failure. Mr.

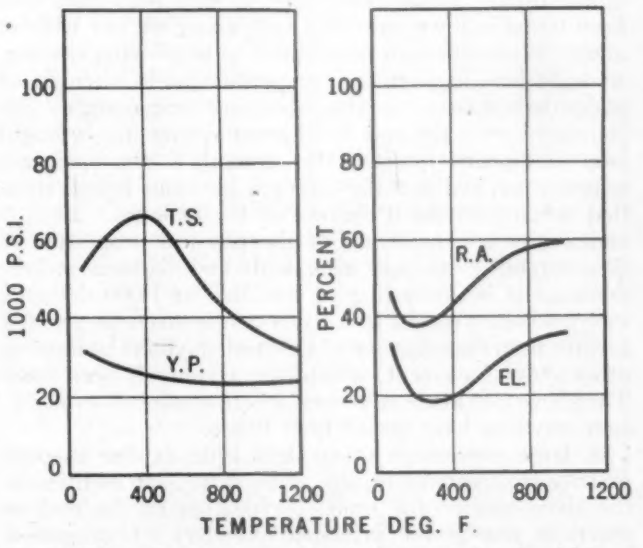


Fig. 7—Effect of temperature on the physical properties of molybdenum wrought iron

McBrian concludes that, had carbon-molybdenum steel been used, it could not have failed at this working stress. This is confirmed by data on elevated temperature physical properties and by the A. S. M. E. Boiler Code Committee's published work on Allowable Working Stresses for various alloy steels at elevated temperatures.

The determination of the temperature gradient in a firebox is one in which many variables affect the calculations, such as the location in the firebox, and the method of measuring coatings of scale and oil. Severe coatings of scale or oil can raise the temperature on the fire-side to 1,250 deg. F. or higher. Cases are reported where circulation lag has raised the temperature to 1,600 deg. F., and there are indications that "flash temperatures" may

approach 1,400 deg. F. Past practice has been to specify materials based on room-temperature physical properties and to ignore completely the fact that the materials are not to be used at this temperature. Figs. 4 and 5 offer a comparison of the elevated-temperature physical properties of standard firebox steel and carbon-molybdenum steel, from which the actual physical properties at operating temperatures may be estimated.

Even an alloy steel will not resist corrugation if there are too few staybolts on irregular or too widely spaced centers for the particular operating characteristics of the type of locomotive involved. These characteristics vary widely and they accentuate the need of a study of photoelasticity on this subject.

Staybolt Failures

Breakage of bolts usually occurs through corrosion fatigue, starting either from fatigue cracks in the root of the threads, or from cracks resulting from the mechanical working of the bolts between the wrapper and firebox sheets. In steel staybolts, this is accentuated by the operating temperature, which lies in the blue-brittle range, and by the susceptibility of steel to aging and subsequent sudden breakage. The bending stress at the wrapper sheet can theoretically be eliminated by the use of flexible staybolts, but this solution still leaves some bending stress at the firebox sheet and does not affect cracks starting at the root of the threads.

The indicated answer seems to lie in an alloy wrought iron, for wrought iron is far less susceptible to aging than steel and is highly resistant to corrosion fatigue. I know of no case where the transverse corrosion fatigue cracks usually found in the body of steel bolts have ever been found in a wrought-iron bolt, either with or without alloy. When, through the addition of an alloying element, wrought-iron is given the compressive yield strength of plain carbon steel at the operating temperatures encountered, then the only valid argument against wrought iron disappears, for it is the strength at the operating temperature and not the strength at room temperature that determines the usefulness of the material. Figs. 6 and 7 give a comparison of the physical properties of double-refined staybolt iron, with and without molybdenum. It is interesting to note that at 1,000 degs. F. molybdenum wrought iron has a tensile strength actually greater than that of some of the steel staybolts containing other alloying elements which have commonly been used. The above also affects the cases where unalloyed wrought-iron staybolts have pulled their heads.

A large percentage of staybolt leaks is due to poor practice in threading, fit, size and spacing. In addition to the above causes for leaks, corrugation of the firebox sheets is one of the principal offenders. Corrugation opens the metal-to-metal seal between the threads of the bolt and bolt hole.

A second cause of leaks is the tendency of the staybolt and of the adjacent material to yield on heating. The remedy for this is the selection of materials with increased compressive yield strengths at operating temperatures. It is interesting to note from the accompanying cuts that the compressive yield strength of plain carbon steel is no greater than that of molybdenum wrought iron at the temperatures involved on the fire-side, where the seal originally exists. In addition, wrought iron has some advantage over steel staybolts in that it upsets more readily in being driven, and hence seals throughout a greater distance. Leaks are also occasionally caused by a change in the type of water used. Where a boiler has operated for some time on alkaline water, a seal has been created by a product of evaporation. This seal will be dissolved upon changing to an acid water, or vice versa.

The advantages of seal welding are that it prevents leakage and gives the careful support to the sheet of a tight, well-fitted, standard type installation. Its disadvantages are cost, possible sudden failure through undetected injury to the sheet material, and possible weld cracks arising from thermal gradient stresses. When conditions permit further development of the explosive-charge method of expanding staybolts in position, the low cost and time saving of this alternate method of giving stays a perfect fit, will undoubtedly have much to recommend it.

On one road, over the past three years, the mechanical inspector advises that by the use of molybdenum wrought iron, he has reduced breakage of crown bolts and flexible staybolts by 80 per cent. No corrosion of bolts or burning of heads was found. Similarly, on an entire class of new power purchased in 1941 and equipped with carbon-molybdenum steel fireboxes and molybdenum wrought-iron bolts, there is a record of no leaks, no cracks and no broken bolts in a service where these troubles were previously severe.

Fitting and Seal Welding of Staybolts

By F. P. Huston

The International Nickel Company, Inc.

A wide range exists among various railroads in standards applied to staybolt thread tolerances, tap tolerances and requirements for fits. The A.A.R., after much study, has proposed the adoption of the Class 3, medium fit, established by the National Screw Thread Commission as the standard to apply to staybolt fits.

What does the Class 3 fit mean when applied to staybolts and how can it be obtained? It means, according to the definition: *threaded parts which are to assemble nearly or entirely with the fingers and must have the minimum amount of shake or play between the threaded members.*

Since it is generally felt that a wrench-tight fit is necessary when screwing the staybolt through the two sheets, acceptance of this definition will require a change in the thinking of those who insist on a fit so tight that considerable force must be applied to the wrench.

Steps to be taken to obtain the Class 3 fit likewise call for changes if the standardization we desire is realized. The first change suggested is the adoption of the specified tolerance limits for screw threads as fixed in the standards for the Class 3 fit. These tolerance limits are: basic pitch diameter plus .000 in. minus .004 in. The next change is the use of taps sized to produce tapped holes which give the desired fit.

The following range of thread tolerances is suggested: From plus .000 in. to minus .002 in. of the basic pitch diameter for staybolts, and plus .001 in. to minus .001 in. of the basic pitch diameter for the matching tap, to under minus .002 in. to minus .004 in. of the basic pitch diameter for staybolts, and under minus .001 in. to minus .003 in. of the basic pitch diameter for the matching tap. Matching taps may be varied according to preference provided the limits set for the Class 3 fit are not exceeded.

Color symbols might well serve to enable the boiler maker to select at once the right tap. Go-no-go gages should be used to sort the staybolts into the two lots which might well be marked green for basic to minus .002 in. and red for under minus .002 in. to minus .004 in. Matching taps are marked in a like manner.

Lead and other errors affect staybolt fits. Staybolts must be threaded on modern threading machines equipped with lead screws if they are to meet lead and other

error requirements. Ordinarily no difficulty is encountered with taps because of these errors except when the over-all thread length on the tap is insufficient to insure continuity of lead in the tapped holes through the two sheets. This latter difficulty, however, is encountered frequently and is important.

To insure continuity of lead through the two sheets with standard reamer staybolt taps, the tapered portion of the threads must enter the second sheet to a sufficient length to maintain the thread cut before the last full thread leaves the first sheet. The minimum over-all length of the threads on the tap must exceed the water space by at least ½ in. and 1 in. is better.

Tapping practice should conform to the following requirements:

1—Taps shall be maintained reasonably sharp.

2—The tapping speed shall not exceed that recognized as good machine-shop practice for the size used.

3—The tap shall be driven in a manner to avoid whip and excessive bending.

4—The threads in the tapped holes shall be sharp and clean. After the full thread is cut the straight portion of the threads on the tap shall be finger free without excessive shake.

The staybolt should be run in right after the tap.

There are approximately twenty locomotives now in service on five roads in this country and in Canada with seal-welded staybolts in the side sheets. Their boilers are fitted with various combinations of staybolts and side sheets, including:

1—⅞ in. dia. straight rigid Monel staybolts in nickel-clad side sheets.
2—1 in. dia. straight rigid iron in nickel-clad.
3—1 1/16 in. dia. straight rigid iron in nickel-clad.
4—⅞ in. by 1 1/16 in. reduced body Monel in nickel-clad.
5—Same as 4 except in steel.
6—⅞ in. dia. straight rigid Monel in steel.
7—1 in. dia. straight rigid iron in steel.
8—1 1/16 in. dia. straight rigid steel in steel.

The oldest application has, to this writing (July, 1944), covered more than twice the average mileage and life obtained under the conventional riveted-over method for their particular service and class. Several others have well exceeded the mileage when patching and staybolt renewals would become necessary with conventional construction. All without exception are free from leakage, corrugations, barnacles and other evidences of foreseeable failure. They appear the same today as when they were put into service.

A striking comparison between seal welding and conventional construction appears in two locomotives of the same class operating under identical service conditions which demonstrates the advantage of seal welding. The advantages of seal welding are shown in the table.

A Comparison of Seal Welding and Riveting the Inside Ends of Staybolts

	Locomotive A	Locomotive B
In service	April, 1943	Jan. 1944
Materials	⅞ in. diameter Monel staybolts in nickel-clad—one side. 1 in. diameter iron staybolts in carbon steel on other side.	Same
Construction	Staybolt screwed through. Ends seal welded on fire side —both sides.	Same except ends riveted-over
Enginehouse maintenance	None	Numerous dumps for calking leaky staybolts. 150 iron staybolts renewed
Condition as of July, 1944	No apparent change	Both side sheets renewed

In order to determine the value of seal welding as insurance against leaky staybolts and cracked side sheets it was necessary to obtain permission from the Bureau of Locomotive Boiler Inspection of the Interstate Commerce Commission to seal-weld the various applications now in service. This permission was freely granted.

Diesel Mechanical Repairs

(*Continued from page 56*)

complete reconditioned units; fuel, water and steam lines should be cleaned and all valves should be inspected and repaired; outer casing, ducts, stack and smoke jack should be inspected and necessary repairs made.

The locomotive water tank should be drained, flushed and thoroughly cleaned and the heating coil and its connections inspected. Lagging or insulation should be repaired as required.

Locomotive water lines, steam lines, air and fuel lines should all be gone over, blown out if necessary to remove accumulated scale and dirt, and all connections, valves, clamps, supports, insulation, etc., should be inspected and repaired. Fuel and water tank filling connections should likewise receive attention.

Trucks should be removed and completely dismantled. Truck frames, brake rigging, springs, equalizers, etc., should be inspected and thoroughly cleaned; equalizers should be tested with the magnetic tester. Pins and bushings should be renewed as necessary and wear plates should be built up or replaced. Journal boxes should be dismantled and cleaned and roller bearings should be checked and cleaned or renewed. Wheels and axles should be inspected and wheels turned or renewed; if the latter, the axles should be magnaflux tested after the wheels are removed. Motor mounting and axle bearings and caps should be given necessary repairs and axle gear should be inspected. Brake cylinders should be cleaned and lubricated in accordance with standard practice and slack adjusters given necessary attention.

The complete air brake equipment of the locomotive should be given the customary system of attention in accordance with the regular practice of the individual railroads.

In like manner other more or less standard mechanical parts of the locomotive such as the cab and its appurtenances, including safety appliances, warning devices, windows, window wipers, seats, arm rests, doors, etc., pilot draft gears, couplers, should all receive necessary attention and repairs. In this connection, it is good practice before release of the locomotive to clean and paint the entire interior (including the Diesel engine generator set or sets) which gets grimy and dirty rather rapidly and does not lend itself readily to cleaning while in service. Opportunity should also be taken to clean thoroughly the under parts of the locomotive of oil and dirt and to clean and paint the battery compartment or compartments with acid-resisting paint. Exterior painting, of course, will be handled in accordance with the regular painting schedule based on service conditions.

When the foregoing maintenance attention and repairs are completed (also the electrical work, which will be described subsequently) it will usually be found to be good practice either to take the locomotive on a test run on the railroad or to utilize its delivery run from the shop, if removed far enough from the terminal, to make a final check of its operating adjustments and conditions before it enters revenue service. While a great deal of this can, of course, be done on the stationary loading tests at the shop, such items as running gear performance, braking, bearing heating, etc., can best be checked on an actual run and this will go far to insure satisfactory operation when regular service is started. An alternative to this is the use of the newly released locomotive in local service for a time before undertaking its regular assignments.

EDITORIALS

Radio for Train Communication

On the basis of extended investigations and hearings held in Washington, D. C., the Federal Communications Commission has issued proposed allocations of radio channels to the various classes of non-governmental services in the radio spectrum from 10 kilocycles to 30,000,000 kilocycles (30,000 megacycles). The Commission proposes that the railroads, jointly with other services, use a few channels below 3 megacycles (mostly for ship-to-shore service); that they have 33 clear channels in the 156 to 162 megacycle range for end-to-end communication and that they use television channels 44-50, 54-78 and 192-216 megacycles for yard and terminal service. These allocations will give the railroads considerable latitude to use radio or carrier systems, or a combination of the two, according to their requirements. Considerable activity in this field can be expected and the Commission urges that applications be made as soon as practicable so that further knowledge of the suitability of the allocations may be determined.

No allotments were made in the 2,600-2,700 range requested by the railroads since there is little knowledge of the performance of radio in these frequencies and apparatus for extended applications will not be available until after the war. This is a completely logical position for the Commission to take, but it is to be hoped that the railroads' former position may be avoided.

Since the early twenties, the railroads have experimented with radio for train communication, but it was never used in regular service, first, because the apparatus available was not completely adequate, and second, because the railroads were obliged to work with temporary experimental wave bands and had no assurance that they could use them permanently.

Now the situation is markedly changed, but some kind of an understanding would do much to assure some highly desirable development work. Research work done by the Rock Island indicates that frequencies in the neighborhood of 3,000 megacycles may be better for train communication than those which have been proposed by the Commission. Of course the Commission has acted properly in not proposing their assignment since, for the present at least, knowledge of performance as well as equipment available is inadequate. The difficulty is that with no assurance that channels in the higher frequencies will ever be assigned for train communication, the railroads are again in a position similar to that in which they were before. They can scarcely afford to spend time and money to study a science the application of which may be denied by government order.

Fortunately, the Commission is completely cooperative. It is evidently appreciative of the technical aspects of radio developments and intends to see that these developments are given every opportunity to be used in the public interest. Fortunately too, as technique is improved to cover the higher frequency bands, an enormous number of new channels are made available. It is to be hoped that some arrangement or understanding may be reached which will not only permit but will encourage the railroads to continue experiments with the higher frequencies.

Speed-Up On Tank Cars

Recently it was announced in Washington that there was an immediate need for at least 15,000 more tank cars for petroleum service than there are available in the country. It was also announced that they could not be built and that a desired increase in petroleum movements would have to be obtained through higher speeds of train operation and quicker turnarounds at terminal points. To the lay reader the solution probably appeared reasonable. But, the lay reader has not seen the existing cars through the eyes of a car-repair-track foreman; he does not know that costs of repairs are even now almost totally disregarded in the interest of quick release of cars at repair points; he does not realize that many railroad operating men consider the present speeds too high for such equipment. He cannot know how much increasing the effective load-carrying ability of the approximately 110,000 tank cars in petroleum service by an additional 14 per cent requires of the mechanical forces now engaged in their upkeep.

We are now well into the third year of heavy movements of petroleum products by rail and only the utmost in cooperation between car owners, the railroads, shippers and consignees has made possible the almost incredible delivery rates which were achieved during 1943 and 1944. There has been time to build new cars but we cannot criticize because they were not built. Other things came first. We can wonder, though, at the newspaper publicity, often government inspired, about

the repairs made to breaks in the "Big Inch" or other pipe lines. Evidently it has never been thought necessary to repair the "leak" in the railroad pipe line resulting from excessive wear and tear on tank cars many of which were almost ready for the scrap pile when circumstances required that they be placed in service.

Knowing railroad carmen one knows that they will do their best to find still further ways to reduce car-repair time on tank-car equipment and to turn the cars over to the operating department in the safest possible condition for high-speed service. Whether their contribution will be enough to help meet the car-deficiency situation is questionable. Certainly, no one envies them their job.

Shop Modernization Programs Are Needed

During 1944 there was more activity on the part of the railroads in the machine-tool and shop-equipment field than has been evident for many years in the past. There are several reasons for this. First and foremost is the fact that the railroads have been out of the shop equipment market for many years and have been wearing out machine tools and shop equipment at an accelerated rate. The combination of wear and obsolete equipment has probably been as much responsible for the sudden buying spurt as any other factors.

Other important considerations influence the roads to invest part of their earnings in new facilities. Acquisition over a period of some 10 years of a substantial number of large modern steam locomotives, most of which are equipped, in part at least, with roller bearings has had a decided influence on the ability of the heavy repair shops to overhaul power with the degree of accuracy required in modern locomotives. The large number of Diesel-electric locomotives, of both road and switching types, that have gone into service in the last five years has made it absolutely necessary to build and equip many new facilities for both light and heavy repair work on this type of power. The stepping up of shop operations involving the internal combustion locomotive and its electrical equipment has brought into the sphere of shop equipment many items heretofore more or less unfamiliar to the railroad field.

Certain factors related directly to operation have also had their influence. High speed, coupled with heavy loads and the necessity for stopping heavy trains moving at high speeds, has been instrumental in creating a wheel problem on practically every railroad. The character of work which it is necessary to do in the average wheel shop today, whether it be for cars or locomotives, is such that it demands a type of shop equipment far superior to that with which the railroads have been getting along for many years. Roller-bearing axles on both locomotives and cars have had their influence on the type of wheel-shop equipment which is needed. It is not surprising that foremost among the demands on the part of practically all roads is that group of machine tools, plus handling facilities, which go to make up a modern wheel shop.

Every shop needs to, and wants to, increase output, and particularly during the past two years when the skilled shop forces have been rapidly depleted as a result of the demands for men in the armed services, this question of output has assumed serious proportions. Unlike many other industries which, because of the peculiar nature of their operations, have kept their plants constantly equipped with up-to-date machinery the railroad shop has been unable to take advantage of many of the new developments in cutting tools and tooling equipment simply because the physical condition and power characteristics of obsolete machine tools made the adoption of these new developments impractical.

As unusual as may be the present activity in shop equipment buying by contrast with the 10 years preceding the war, most of the railroads find themselves in a difficult position with respect to their ability to improve shop output and reduce the costs of maintenance. In spite of an excellent cash position their lack of definite improvement policies in the matter of shop and engine-terminal facilities over a period of years has been responsible for a vast accumulation of obsolete equipment, housed in many cases in shop structures that were built years ago when a far greater number of locomotive units had to be put through the shop at more frequent intervals. The result of all this, which we are witnessing today, is that we have many shops poorly suited to present-day needs, in which the high cost of handling heavy parts is occasioned by the inability to arrange and re-equip departments in such manner as to take the greatest advantage of modern cost-saving facilities. If some accident of fate should make it necessary for many railroads to cut their shop floor space in half and do the necessary things to modernize the remainder the chances are that the cost of doing work would be materially reduced.

This condition is responsible, in many cases, for indecision in the matter of shop improvement programs. Most railroads do not have any such programs, except in name. That which is needed most today is a thorough engineering study of the problem of equipment maintenance. The character of this problem has changed drastically in the past five years but our thinking, in the matter of repair facilities, is still much along traditional lines.

It is not surprising that railroad managements at times have difficulty in trying to decide whether or not a million dollars will return most in value if invested in shop equipment, new locomotives, new cars, roadway improvements or in some other facility. Each department of a railroad, engrossed as it is and should be, in its own peculiar problems, can, as a rule, put up a pretty strong argument to the management for the

necessity and justification for its requests for appropriations. The departments most successful in maintaining the modern character of their facilities are probably those which have the most complete and factual data coupled with executive personnel who have that rare ability to sell management to the idea of spending money to make money.

If there can be attributed to railroad managements any defect in their present course it is in allowing things to take their course; by this process, on many roads, the cost of maintaining equipment is not being reduced at a time when there never was so much available in the way of modern facilities for accomplishing that very purpose.

Many railroad managements are prone to look outside their own organizations for assistance in the matter of improvement programs. The difficulty in this is that there is nowhere to go to get the help. It has to come from within and it is a problem that can be approached only from an engineering standpoint—not mechanical engineering alone, nor civil, electrical or production engineering alone but a combination of these several approaches to a problem that involves all of them. For, railroad operation today is a complex job in which it is quite possible to spend millions for a facility of one type and be denied the real value of that facility because of the failure to provide collateral facilities with which to keep it in service. The true facts of the equipment-maintenance case are that maintenance facilities *have not* kept pace with the equipment itself and management must recognize this.

Treating Boiler Feedwater

As pointed out by W. A. Pownall, assistant to the superintendent of motive power, Wabash, in a prepared discussion of feedwater treatment at the recent annual meeting of the A. S. M. E. Railroad Division in New York, most railroads now use some form of water treatment to reduce or prevent scale formation in locomotive boilers. They have competent water engineers for supervising the treatment, and manufacturers of boiler compounds have well-organized forces of traveling representatives who understand the principles of water treatment and who instruct and supervise the carrying out of treatment on individual railroads.

One fact, perhaps not always appreciated, is that the decrease in locomotive failures due to leaking flues was largely effected by the electric welding of flues to the back flue sheet and this reduced the urgency and doubtless to some extent delayed effective boiler water treatment. Years ago, roads operating under hard-water conditions had a great number of road delays caused by leaking flues and they were forced to adopt some form of water treatment to reduce scale formation which frequently caused locomotive failures on the road. On the Wabash, for example, in the pre-treatment days, there were nearly 1,000 locomotive leaking flue failures in a year, which may be compared with one failure a year, at present.

This notable improvement has not been due to welding, as small flues, or tubes, are not welded to the flue sheet on this road. It must be credited largely to effective water-treatment which was begun in 1912 and consisted essentially of the soda ash treatment, alone, except at one point when high hardness and high iron content justified a lime-soda plant.

The following specific improvements are listed by Mr. Pownall, as possible with effective modern boiler water treatment. Practical elimination of locomotive failures caused by leaking flues, staybolts or fireboxes; increase in time between flue resetting from 6 to 12 months, to 4 to 5 years; 95 per cent reduction in broken staybolts; firebox renewals reduced from 12 to 0.4 per 100 locomotives per year; firebox sheets or part sheet replacements reduced 90 per cent; period between boiler washout increased from 10 to 30 days; fuel consumption reduced 10 to 20 per cent.

It is obvious that successful treatment of boiler feedwater requires continuous addition of the prescribed chemical dosages to all waters, and promptness is of prime importance in translating road checks of water condition into corrective action so as to avoid, as far as possible, even temporary over or under treatment. The blowing down of locomotive boilers is essential in order to relieve foaming conditions and one point, made in the discussion, is that the main blow-off cock should be located in the back corner with a perforated pipe connected to it and lying on the back mud ring.

Undoubtedly, greater emphasis should be placed on securing in every case the best possible source of water supply. As pointed out by Mr. Pownall, any plan of water treatment should include a careful survey of existing supplies, with a view to replacing bad water with waters of better quality providing the expense of the change is not prohibitive. Well waters that carry a moderate amount of sodium carbonate are already treated and need no control. In one instance on the Wabash, for example, a well water high in sulphate hardness required many tons of soda ash annually to render it non-scaling. After a careful survey, another strata was located within a mile of the old location; the new water had about one-third the total hardness and contained two grains of sodium carbonate per gallon; no treatment whatever was required with the new supply.

Without this sort of intelligent effort in securing the best waters available, treating them where necessary and developing satisfactory equipment and technique in blowing down locomotives on the road, it would have been absolutely impossible for the railroads generally to make the records of locomotive performance, attained in recent years and culminating in 1944.

IN THE BACK SHOP AND ENGINEHOUSE

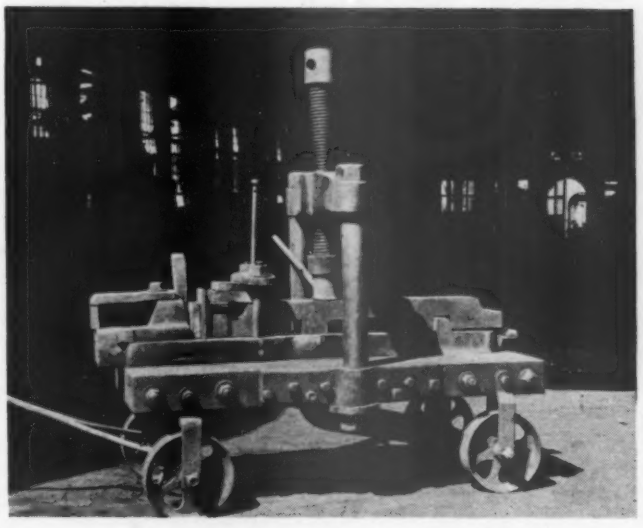
South Tacoma Shop Devices

The centering device for locomotive cylinders illustrated has six self-centering guides, screw operated. When placed inside the cylinder with the guides in contact with the cylinder wall, the long rod is in the exact center of the cylinder. The pointer on the long rod serves as a guide for measuring and locating top and bottom crosshead guides and for aligning them in proper relation to the cylinder.

A convenient arrangement of levels for setting up locomotive shoes and wedges in a shaper for machining is shown in another illustration. This device is attached to the shoe or wedge at three points, using the center punch marks made in laying out. The table is then adjusted at the end and sides until both glasses show level. This device is made right and left.

A third illustration shows a convenient device for closing locomotive pedestal caps. It consists of a truck-mounted, heavy steel slab equipped with a substantial crossbar and 2½-in. vertical adjusting screw which is used to hold the pedestal cap in position for heating and upsetting. The cap is heated with an acetylene torch at a localized point and pressure applied by driving in the wedge with a sledge. This makes close adjustment possible at the exact location desired, and saves considerable time as compared with heating the entire pedestal cap.

These devices are in use in the South Tacoma, Wash., shops of the Northern Pacific.



Device for closing locomotive pedestal caps

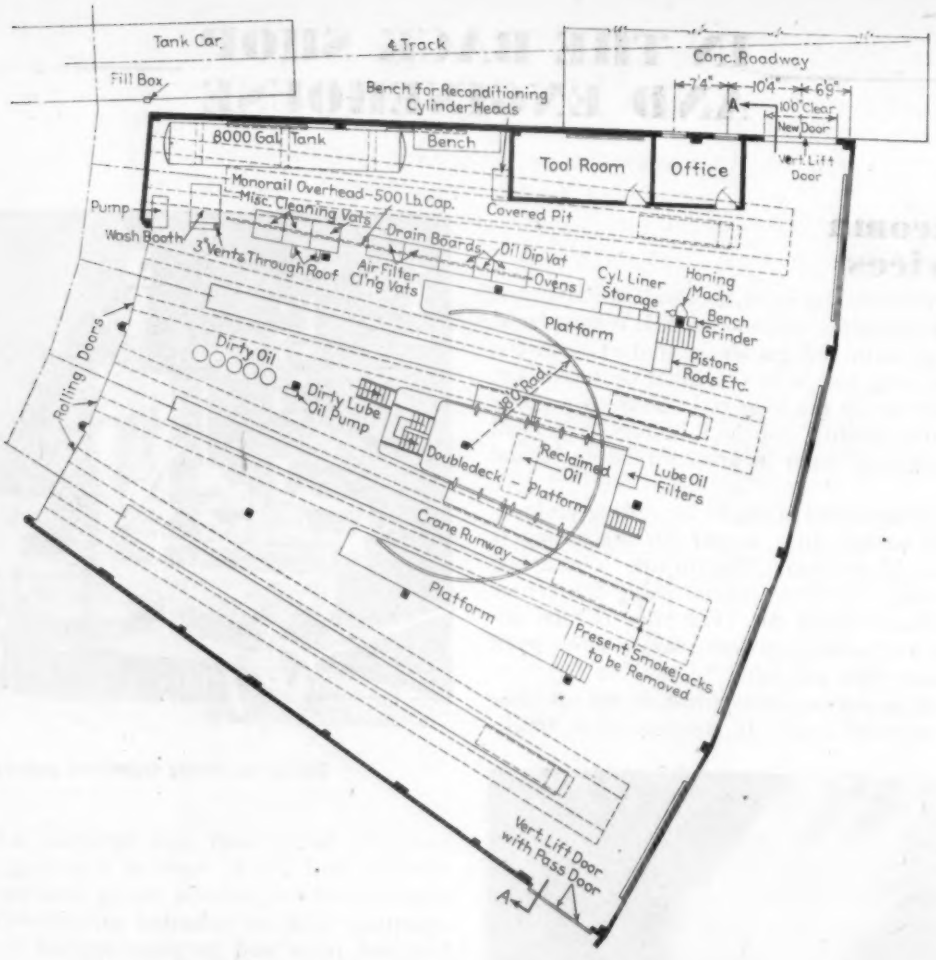
Centering device for locomotive cylinders

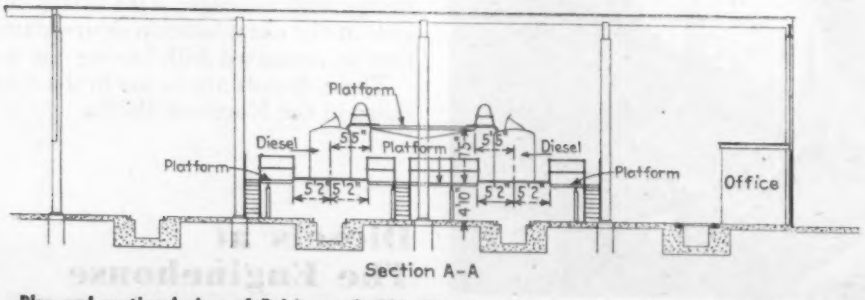
Levels used for setting up locomotive shoes and wedges for machining

Diesels at The Enginehouse

At the present time the Baltimore & Ohio has 15 Baldwin-Westinghouse 1,000-hp. Diesel-electric switching locomotives operating in its Philadelphia, Pa., terminal area. The question arose before these locomotives were placed in service as to what type of maintenance and repair facilities should be installed to care for them. It was decided that a portion of the East Side enginehouse could be adapted for this work at a minimum of expense and that it would be possible to install adequate and satisfactory facilities. Four stalls at one end of the enginehouse were walled off from the rest of the house; the doorway of the end stall was walled in solidly and the other three stalls were fitted with overhead roll-type doors. The rear and end walls consist almost entirely of windows.

The space made available by closing off the end stall was utilized for the installation of an 8,000-gal. lubricating oil tank, cleaning vats for filters and other parts, a tool room, storage space, a honing machine, other shop tools and an office. The remaining three stalls all have pits to permit necessary work being done under the locomotives. However, most of the work done in the shop is done on the two tracks nearest the tool room. A





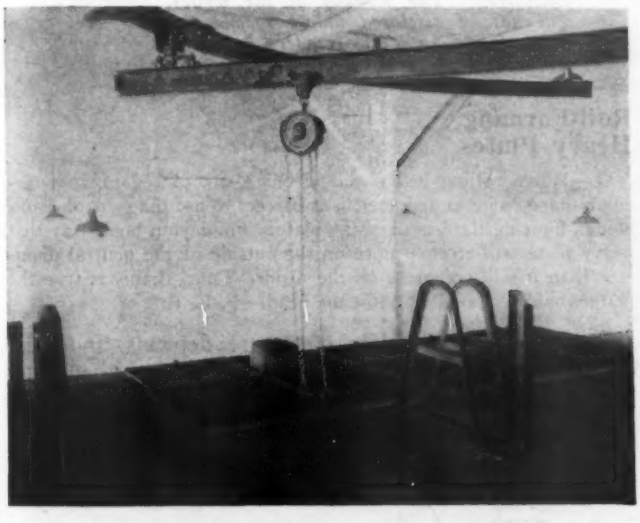
Section A-A

Plan and sectional view of Baltimore & Ohio Diesel maintenance facilities at East Side engine-house, Philadelphia, Pa.

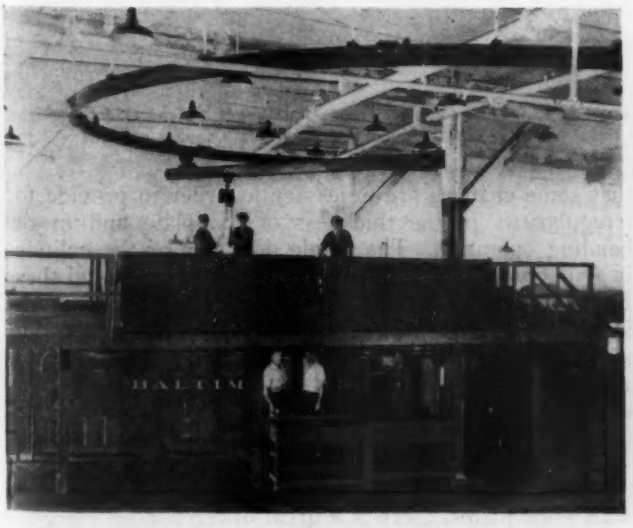
Left: The three stalls have inspection pits—Right: The two-level platform permits easy access for engine inspection and repair

two-level working platform was built between these tracks which gives access to all parts of the locomotives which may require inspection or repair. There are work benches for tools and parts on each of the platform levels. The upper level is served by a one-ton chain hoist mounted on a carriage which travels on a swinging boom. The boom is supported at its outer end on a curved track which has a 180-deg. swing. The use of this hoist permits the removal of heads, liners and other heavy parts which must be removed through the roof hatches on the Baldwin locomotives. Hinged steel-plate platform side extensions are lowered onto the top of the engine hood when the top platform is in use.

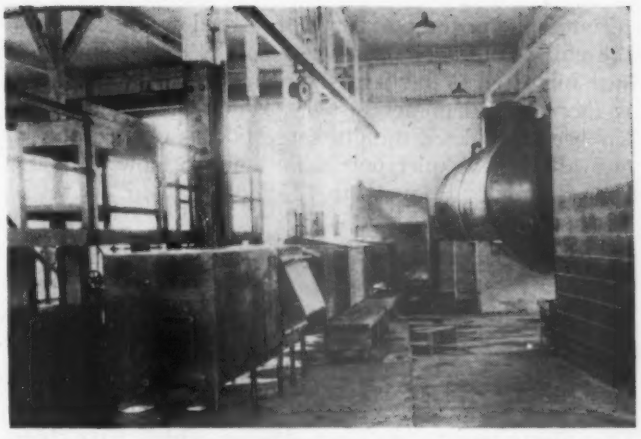
Apart from the use of the double-deck platform other features of the shop do not differ greatly from those ordinarily required in Diesel maintenance shops. Single-level platforms on the outside of the two tracks which are separated by the double-deck platform, give access to engine parts which can be reached through the side doors in the engine hood. The pits are not lighted. This feature was not considered necessary because of their relatively short length and the generally good lighting conditions in the shop through the windows and from the numerous overhead lights which have been installed. When extra light is needed in the pits, an ordinary drop light on an extension cord is used.



A chain hoist is used to handle heavy engine parts



The two-level platform is located between the working tracks



Filter cleaners and drying ovens are adjacent to the repair tracks

When wheels require removal it is necessary to use the regular drop-table facilities of the enginehouse. The railroad is prepared to make an installation exclusively for Diesel use if experience shows it to be necessary but, to date, the volume of such work has not resulted in delays to either steam or Diesel power.

Regular daily inspections of the switching locomotives are usually made during crew lunch hours in the territory where the locomotives are operating or at times when it is necessary for them to take fuel. Monthly inspections, of course, are made at the enginehouse. In general the inspection and maintenance procedures outlined in the Guide for Inspection and Care of Baldwin-Westinghouse Diesel-Electric Switching Locomotives are followed although the report forms used on the Baltimore & Ohio are set up somewhat differently than those which are available from the manufacturers.

Superheater Unit Tester

All superheater units removed from Southern locomotives at the Spencer, N. C., shop are tested hydrostatically at pressures which reach 1,000 lb. per sq. in. The unit being tested is first laid across two trestles and the ball-joint ends are fitted firmly against the head of the testing device. A slotted projection on the face of the test device passes through the superheater unit clamp and a steel wedge driven through the slot holds the unit tightly in position. Water is then admitted to the unit

Showing head of hydrostatic testing device for superheater units with a unit in place—Test pressures of 1,000 lb. per sq. in. are used

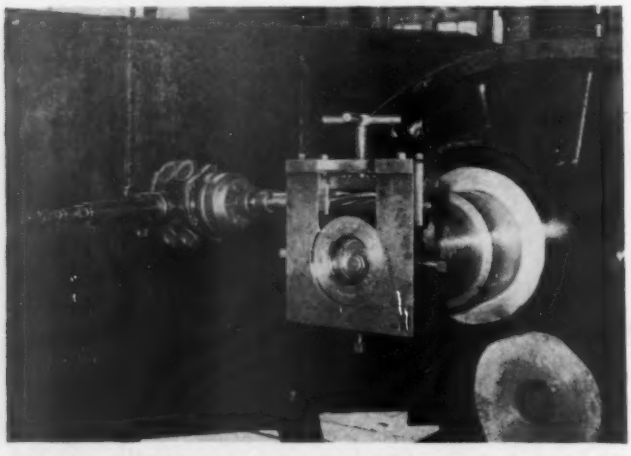
through one of the ports until an overflow indicates that the unit is full. The discharge port is closed and pressure increased to the desired amount after which the unit is thoroughly hammer tested. When the hammer test has been completed the discharge port is opened and an air valve at the inlet port admits air to blow all water from the unit. From 10 to 12 units per hour are tested in this way.

Crank-Pin Milling Machines

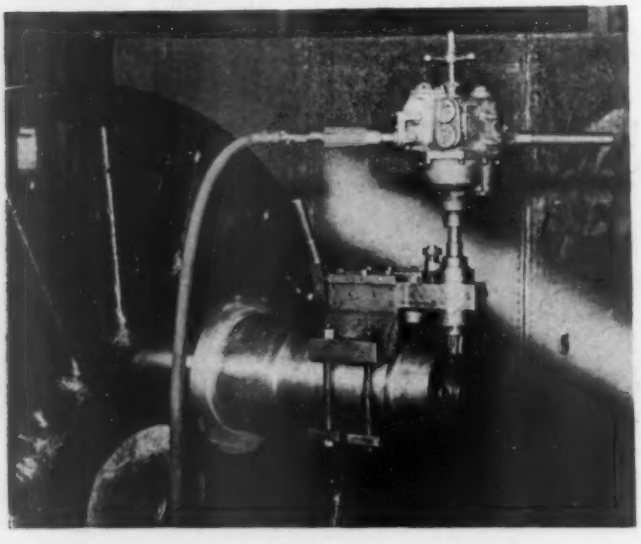
The illustrations show two devices which have been used with good results at the Northern Pacific shop, South Tacoma, Wash.

Referring to the first view, the machine illustrated is used for milling eccentric-crank keyways in the ends of locomotive crank pins. This machine consists of a V-block clamped to the crank pin and designed with a sliding bar support for the air-motor-driven end mill which performs the actual cutting operation. Cross-feed of the cutter-support bar is secured by means of the hand ratchet shown on the left of the machine which engages a screw used for feeding the milling tool into the crank pin.

A companion machine used for milling main locomotive crank pins for eccentric-crank-arm bolts is shown in the second view. This device consists of an inverted U-block which fits over the end of the crank pin and is held in place with set screws. The air-motor-operated milling cutter is supported in two steel bearings attached by a crossbar, this entire unit being capable of verticle motion in the U-block by means of the hand screw shown at the top of the machine. Operation of this hand screw, with the air-motor running, feeds the milling cutter quickly and easily into the crank pin to the desired depth.



Machine for milling main locomotive crank pins for eccentric-arm bolts



Machine for milling eccentric-crank keyways in locomotive main crank pins

Locomotive Boiler Questions and Answers

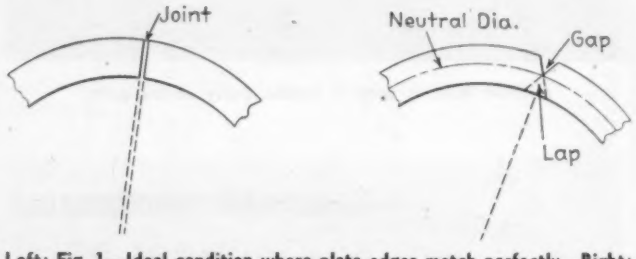
By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Roll-Forming Heavy Plates

Q.—When rolling heavy plate from ¾ in. to 1¼ in. to a circular shape 54 in. in diameter, is it correct to use the neutral diameter in figuring the length of the plate? The layout books say that heavy plate will stretch more on the outside of the neutral diameter than it will compress on the inside. Thus, if this is true the plate would be too large to fit the head.—F. E. R.

A.—The allowance for curvature depends upon the diameter of the curve and the thickness of the plate. The allowance can be calculated, but it often happens



Left: Fig. 1—Ideal condition where plate edges match perfectly—Right: Fig. 2—Result of cutting heavy plate square on ends

that some changes are necessary in order to provide for irregularities in the thickness of the plate and in the bending operation. The inside diameter of the cylinder is stated and the thickness of the plate is given and these figures are used as the basis of the calculations. The inside circumference is supposed to shorten and the outside is stretched in the rolling operation. The line midway between the inside and outside is supposed to be the same length after the plate is rolled as before, and therefore this is called the neutral axis.

If the calculation is made on the neutral diameter, then theoretical results would apply in practice. However, with thick plates, there is a great difference between the length of the inside circumference and the outside one

and a special allowance should be made in order that the two edges of the plate will roll together. The desired condition is shown in Fig. 1. The two edges match perfectly, and the joint would be finished with cover plates.

The condition where the edges meet at the neutral point but overlap at the inside circumference and fail to meet at the outside circumference is shown in Fig. 2. In this instance the ends of the plate were cut square, and there was not enough compression on the inside or enough stretch outside.

Fig. 3 shows the form of plate when cut according to the calculated length for the inside circumference, the neutral circumference and the outside circumference.

It will be seen that the distance between the lengths of the inside and outside circumferences is twice the thickness of the plate multiplied by 3.1416, or it is the thickness of the plate multiplied by 6.28. Instead of using this fractional value and making some allowance for the irregularity that may be due to the plate and the

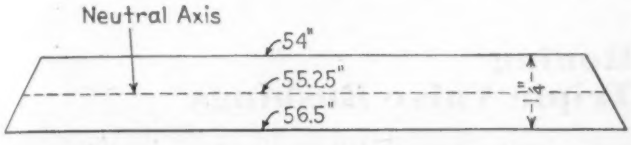


Fig. 3—Form of plate when cut to calculated dimensions for proper bending

rolling operation, some plate workers recommend the use of a factor of seven.

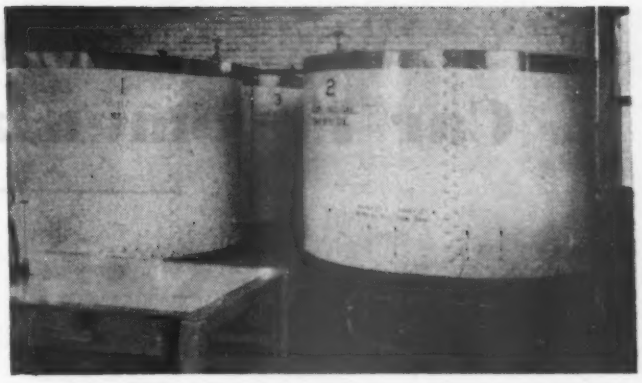
In the problem of the 54-in. cylinder made of 1¼-in. plate, the inside circumference is 54 × 3.1416, the neutral circumference is 55¼ × 3.1416 and the outside circumference is 56½ × 3.1416. It should be noted that the plate must be cut for the outside length. The difference between the inside and the outside lengths is 2½ × 3.1416 or twice the thickness × 3.1416 which equals the thickness × 6.28. It is recommended that a factor of seven be used in order to insure that the outside circumference will be long enough to satisfy all the needs.

Reclaiming Lubricating Oil

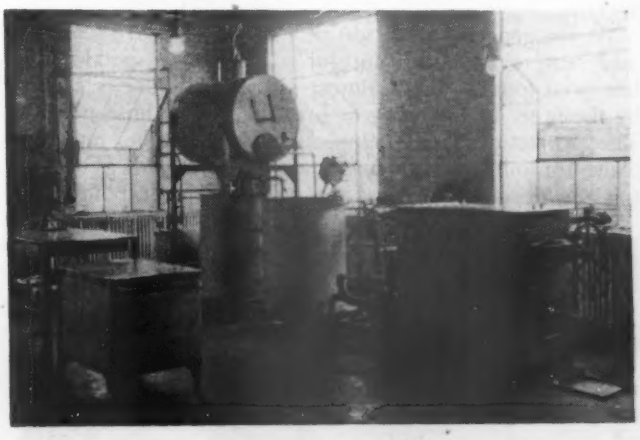
In the December, 1944, issue of the *Railway Mechanical Engineer* on page 549, certain of the Diesel-electric locomotive servicing and repair shops of the Southern railroad were described. The photographs here show the lubricating-oil reclamation facilities which are employed at Chattanooga, Tenn., in connection with the repair shop at that point. Operated by the stores department, they are actually an integral part of the repair and maintenance facilities of the mechanical department.

As used oil is removed from crankcases in the shop it is pumped through a pipe line to the dirty-oil storage tanks. The oil is drawn from these tanks and undergoes a re-refining process after which it is stored in tanks until the engineer of tests has checked samples and verified the fact that the oil meets all specifications for crankcase use. When approved the oil is pumped into the shop-servicing lines and used to fill completely drained crankcases or as makeup oil in others.

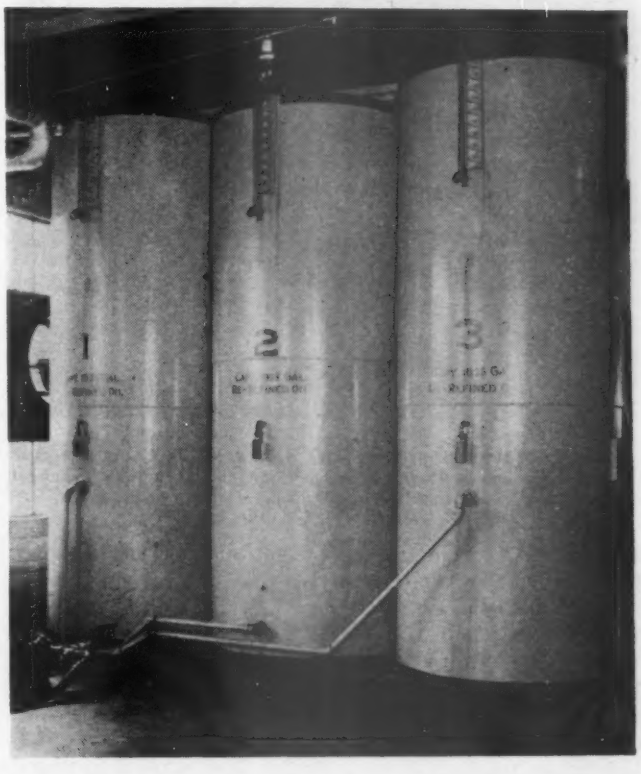
This system does away with any necessity for drum-handling of oil and meets the recommended practices for oil-reclamation facilities at Diesel-servicing points where the volume of work justifies such an installation.



Oil removed from crankcases in the Diesel shop is pumped to these dirty-oil tanks located in the oil house



An installation for re-refining used Diesel engine lubricating oil



Tanks from which re-refined oil is pumped to the Diesel maintenance shop servicing line

With the Car Foremen and Inspectors

Air Hose Equipment

Air hose in railroad service is usually changed on a specific time basis, but on the Independent subways of the New York City Transit System the air hose is changed only when examination indicates that abrasion or other mechanical damage makes the hose unfit for service.

At the general inspection period air hoses are removed and sent to the air room for a physical inspection. It has been found that in almost all cases, failure is caused by the inner tube cutting or breaking at the hose nipples. The projection of the nipples inside the tube, makes a place for oil and condensation to be trapped. This results in decomposition of the rubber at that point, and

The inside of the hose near the ends is inspected by means of a small battery lamp and a 45-deg. mirror on the end of a tube somewhat smaller than the inside diameter of the hose

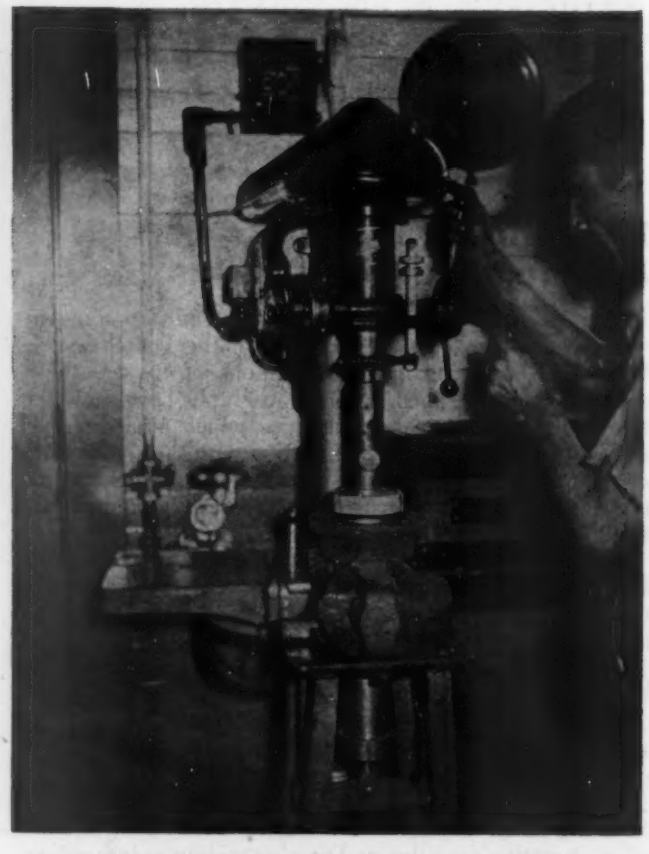
when deterioration reaches a certain degree the hose blows off the nipple.

Physical inspection is made, as indicated in the illustration, with an inspection device consisting of a mirror mounted at 45 deg. near the base of a tube with a small battery lamp behind the mirror to supply the necessary illumination. The tube is inserted into the hose and conditions at the end of the nipples carefully inspected. Hoses that do not show any visible defects are then tested under 125 lb. of air and returned to service if O. K. This method has made it possible to extend the life of air hose in some cases to a point that is hard to believe. The railroad has air hose in service today that has been in operation over twelve years and which was manufactured two to three years before being placed in service.

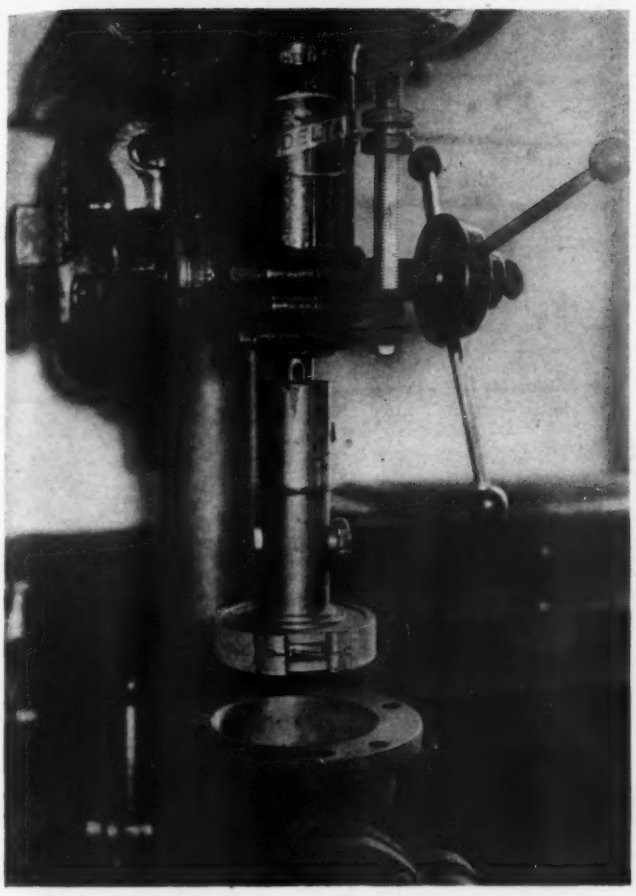
Each Independent System car has 16 hoses of various sizes and lengths, a total of over 27,000, and a large saving of critical rubber has been made in this item alone.

Honing Triple Valve Bushings

Triple valve bushings are honed at the Chattanooga, Tenn., car shops of the Southern with a tool built for use on a drill press. The tool consists of a hollow spindle in which there is a screw-adjusted tapered wedge which serves for making adjustments in diameter on the honing shoes. This is accomplished by expanding a ball-bearing ring, the outer edge of the balls in turn exerting an expanding force upon the inside surface of the honing shoes. The two shoes are connected together and held against the ball race with tension springs. A fine carborundum cloth is used on the shoes. It is applied with a



A specially designed honing tool for triple valve bushings is used on a drill press having a spindle speed of about 400 r.p.m.



The honing shoes are covered with a carborundum cloth which is shellacked in place on the faces of the shoes

thin even coat of shellac and held in place with a retainer ring until the shellac is thoroughly dry.

Honing operations are performed at a drill press spindle speed of about 400 r.p.m. The triple valve bodies are held by an air clamp built by the shop forces and permanently fixed to the drill press base. This mounting does not prevent the use of the drill press for other work.

Specification For Tank Cars—Center Sills

Under date of December 8, the A.A.R. Mechanical Division referred to the question of permissible use of A.A.R. Z-section center sills on tank cars which has been before the Committee on Tank Cars and Committee on Car Construction and said that a center sill composed of two members, A.A.R. Z-26 section, total weight 82.4 lb. per ft., having a total area of 24.24 sq. in., is acceptable as an equivalent of the built-up type sill of 30 sq. in. area, as required in the A.A.R. Specifications for Tank Cars.

Therefore, Par. 2(d) Sec. H-Car Structure of the A.A.R. Specifications for Tank Cars, is modified to read as follows:

2(d) Center Sills.—The center sill construction must meet the following requirements:

Minimum center-sill area between points of impact, 30 sq. in. Note—A center sill composed of two members, A.A.R. Z-26 section, total weight 82.4 lb. per ft., having a total area of 24.24 sq. in. is acceptable as an equivalent of the built-up type sill of 30 sq. in. area as specified above. Ratio of unit stress to end load for center sills, not more than 0.05. Ratio of unit stress to end load for draft attachments, not more than 0.125. Length of center- or draft-sill members between braces must be not more than 20 times the depth of member, measured in the direction in which buckling may take place. Continuous sills are preferable; sills other than Z-26 to have a cover plate. Other center sill construction or materials, when approved for tank cars, may be used.

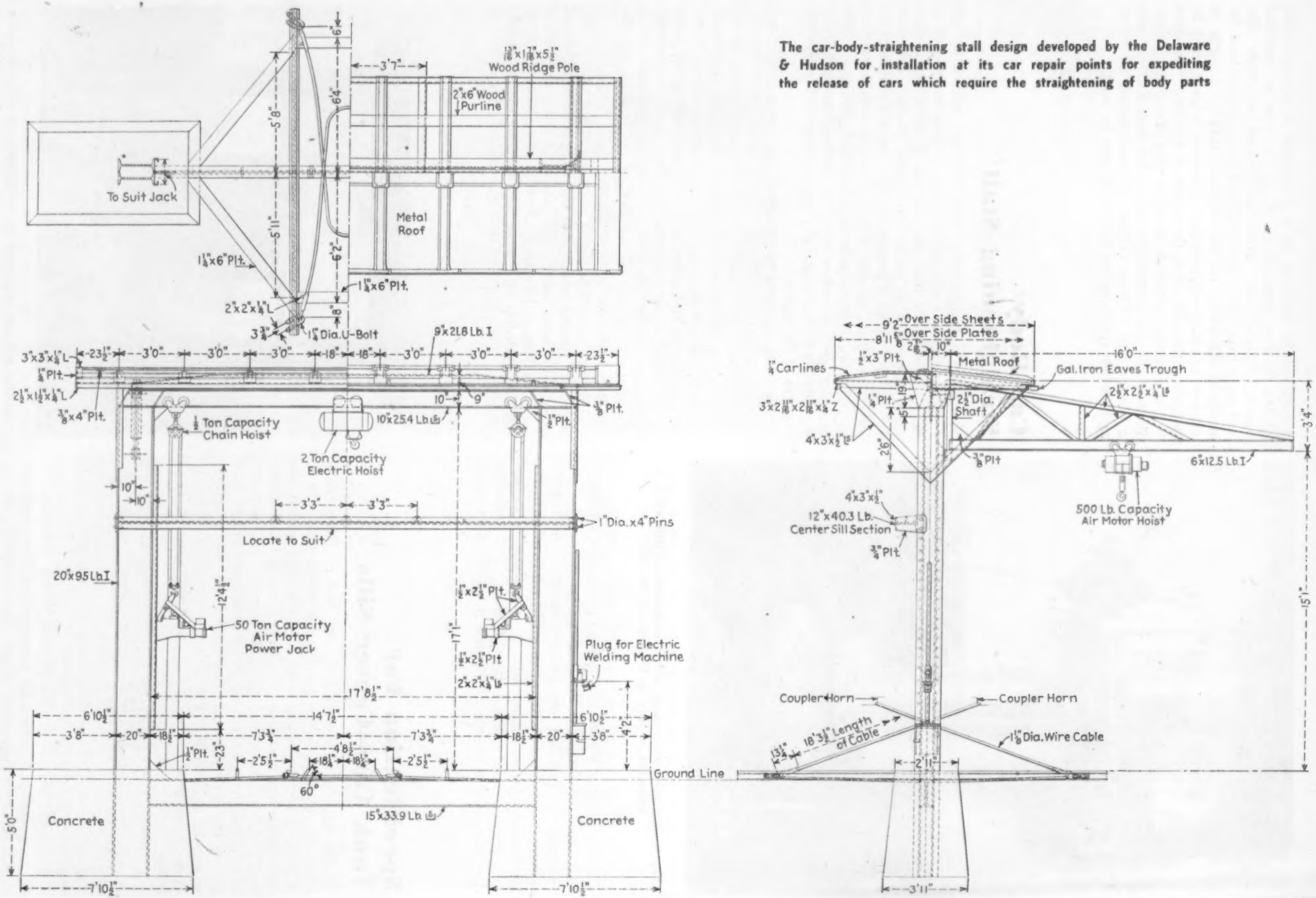
Car Body Straightening Stall

A car-body-straightening stall recently erected at the Oneonta shops of the Delaware & Hudson has proved to be so satisfactory that the railroad is installing similar stalls at each of its major car repair points. The shop forces have found it possible by the use of the stall to release many cars to service that formerly would have required more or less complete stripping to straighten bent body members or center sills. The photographs and drawing illustrate the essential construction and operating features of the stall.

The force required to straighten car parts is obtained through the use of 50-ton air-motor jacks which are suspended from chain hoists and move vertically in sliding ways on the stall side posts when used for straightening top rails, side stakes, side sills and center sills. If end bulb angles or end gates require straightening the jacks are mounted against a stress member which is fastened in position on the side posts. A variety of heads can be mounted on the end of the ram of the jack to suit the contour of the part being straightened.

Although wreck-damaged cars in which center sills have been sprung or bent can and have been straightened successfully with considerable saving in time, the bulk of the work done in the stall has been in straightening spread sides on open-top equipment and in straightening bulged car ends. This last has been particularly important in

Crossbar and jack in position for straightening an end bulb angle



The car-body-straightening stall design developed by the Delaware & Hudson for installation at its car repair points for expediting the release of cars which require the straightening of body parts

The head used in straightening side stakes

enabling the D. & H. to maintain required hand-brake-wheel clearances with a minimum of out-of-service time for cars which require only this attention.

When side stakes or other parts on the side of the car are to be straightened because of a bulge, the car is first positioned in the stall opposite the jack heads. The jack on the side opposite the bulge is operated first until its head contacts the car side, stake or sill opposite the member requiring straightening. With this in place to hold the car for the exercise of a straightening force, the opposite jack is advanced sufficiently to straighten the damaged member. In practice the jack is advanced to a point where a slight reverse bend appears in the member to compensate for springing. Upon release of the pressure this reverse bend disappears. The skill required to estimate the correct degree of "over-straightening" is quickly acquired. If it is necessary to straighten sides or other members which have been bent inward, the straightening jack is released from the sliding ways on the stall post and operated against blocking inside the car to press out kinks.

Straightening on the ends of cars is accomplished by holding the car in position against the force exerted from the jacks with a steel wire cable which is anchored to the rails and looped over the coupler horn. With the jacks mounted on the cross member which is fastened to the side posts, bulges or kinks are easily removed. Bent corrugated-type end gates on gondola equipment are also straightened by this method using a special head on the jack. Holding clamps prevent the door from being broken loose from the end-gate locks.

A most important time-saving advantage of the stalls was discovered when an attempt was made to readjust a shifted load of lumber which, otherwise, would have required transferring. The necessary adjustments were made in several hours and the load of lumber restaked; transferring the load would have required from two to three times the number of man hours.

Journal Box Inspection and Lubrication

As officially announced, the A. A. R. Mechanical Inspection Department has made an investigation of practices being followed by the railroads and private car lines in connection with inspection and lubrication of journal boxes. Unsatisfactory conditions have been found at repair tracks and shops visited, the most predominant irregularities being as follows:

1—Packing in storage not properly saturated.

2—Improper waste reclamation, lumps, rolls, etc., not removed and packing not in proper resilient condition.

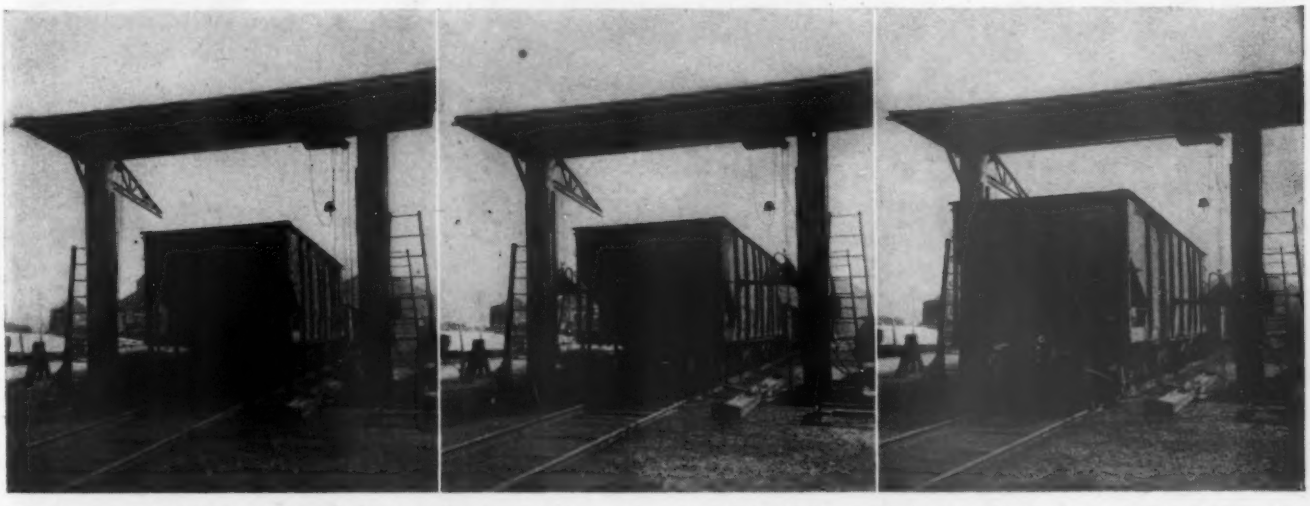
3—Supply of packing exhausted and cars over-due for periodic inspection and repacking, forwarded in service without necessary attention.

4—Excess amount of free oil used during periodic attention.

5—Interior of journal boxes not properly cleaned prior to repacking.

6—Improper reclamation of journal bearings, resulting in loose lining and other irregularities.

7—Missing or defective dust guard plugs not renewed during periodic attention or in connection with wheel exchanges.



Left: Hopper entering stall—Center: Jacks in position to straighten a side stake—Right: Taking out bulge in a side sheet and straightening a stake

8—Loading of cars where journal boxes are over-due for periodic attention.

9—Improper storage of journal bearings, resulting in injury to bearing surface.

10—Packing irons with short blades.

11—Flat condition of wedges not determined during periodic inspection.

12—Missing, loose fitting or otherwise defective journal box lids.

13—Journal bearings worn out.

14—Tendency of permitting packing too high, above 1 in. below center line of journal, frequently found to be up against bearing immediately after periodic attention.

15—Inspection and conditioning of journal boxes on inbound movement, with no further attention prior to train departure to correct conditions that may result from gravity yard or hump switching, weighing of cars and other yard handling, and reverse movement of trains.

16—Packing in boxes contaminated with water, dirt, sand, gravel, wood, rags, rust, and other foreign matter,

17—Packing in boxes dry, not evenly distributed, rolled and up against the journal bearings, worked forward and up against journal box lids, and exeessive or insufficient.

18—Practice to work front of journal box only, rather than follow through with the packing iron.

19—Waste grabs under journal bearings on cars lined up in trains O.K.'d and ready for departure.

The purpose of the circular letter calling attention to unsatisfactory conditions existing and irregularities is to suggest that each railroad and private car owner make investigation at his own shops and repair tracks and take immediate action to insure compliance with the present rules and standards, instead of waiting until each individual railroad and private car owner's facilities are investigated by the A. A. R. Mechanical Inspection Department.

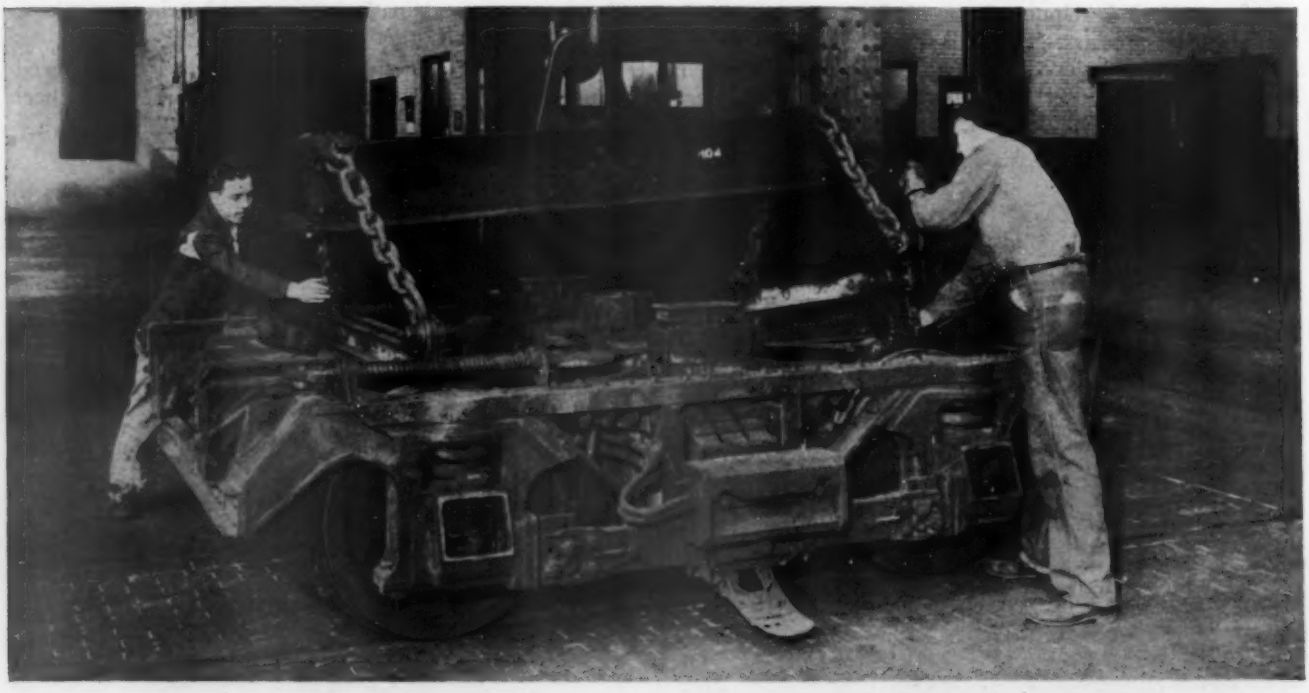
Conditions noted by the inspectors in the field indicate that where lubrication and inspection of journal boxes are followed closely, a better than average performance has resulted. The circular states that, where this work is neglected or improper methods and conditions are detected, invariably the results are an increased number of hot boxes with resultant delays, damage and expense.

Sling For Lifting Trucks†

In the shops of the New York City Transit System, which maintain 1,700 cars, a great many trucks are handled every day. Movement from the car-body shop to the truck shop and to the various bays in the main shop made it necessary to have a quick, reliable method for handling them. The sling illustrated enables two men to prepare a truck for movement in the matter of seconds instead of the usual time required if chains, wedges, etc., are used. This fixture picks up the truck by the inside of the throat of the wheel and therefore does not disturb the relationship of any of the truck parts such as journal bearings, keepers, springs, bolsters, etc., because the reaction is through the wheel. The cam action on one side of the sling makes it impossible to drop a truck.

When the track is raised the reaction is through the wheels the same as when standing on the track

† Abstract from a paper by B. F. Cordts, engineer, cars and shops, New York City Transit System, presented at a meeting of the Transportation Group, A. I. E. E., New York, on November 14, 1944.



The lifting hooks are slipped inside the throat of the wheel and are held in position by the pull of the lifting chains

Clean Air For Passenger Cars

By W. M. Hutchison*

Precipitron electro-static filters in regular railroad service have removed 90 per cent of the dust passing through them

REMOVAL of fine air-borne dust particles makes possible economies in the maintenance of interior finishes and furnishings not previously obtainable; and during a period of 18 months' operation on two streamliners they have afforded definitely increased passenger comfort. Tests made during the period of operation showed that the Precipitrons removed 90 per cent of the dust particles brought into the car.

Before the development of the Precipitron, no practical method had been devised to effectively rid the air of very small dirt particles. The size of such particles is commonly measured by a minute metric unit known as the micron. A micron is equal to about 1/25,000 of an inch. As an illustration, a particle one micron in diameter when magnified 25,000 times would be approximately one inch in diameter, somewhat smaller than a golf ball. Sizes of dirt particles found in the air in motion range from heavy industrial dusts of 8,000 microns down to

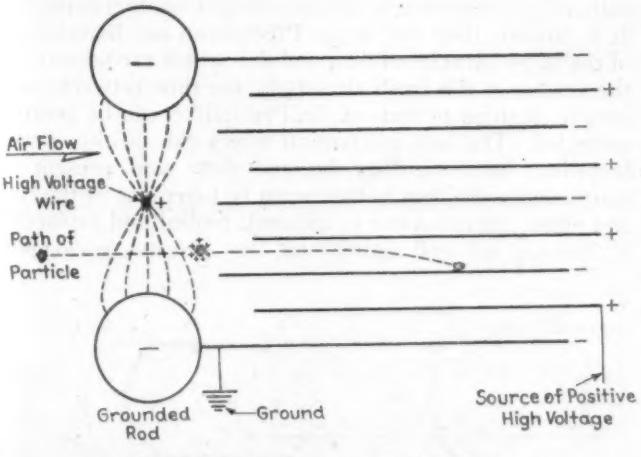


Fig. 1—Principle of operation of the Precipitron

tobacco particles as small as 1/10 of a micron. Mechanical filters are effective in removing the larger particles, that is, diameters of about 5 microns or more, but they are not effective in extracting the very fine particles which actually make up from 80 to 90 per cent of the total and which are less than one micron in diameter. The only effective method known today to remove these very fine particles from an air stream is by electrostatic precipitation.

One of the earliest practical applications of this principle was made early in the present century in the Cottrell precipitator, which has been eminently successful in such highly specialized applications as boiler and smoke stacks, and in reclaiming valuable dusts and particles in industry. However, the high voltages used in the Cottrell system, from 30,000 to 100,000 volts, cause such a high generation of ozone that the air thus treated is not safe for breathing and hence not suitable for ventilating systems. The Precipitron, on the other hand, operates at voltages which generate so little ozone that its concentration is in the order of that found out-of-doors on a bright, sunny day. A further advantage is that the Precipitron requires but 1/50 the space for installation that the Cottrell cleaner does for a given volume.

The principle of operation is indicated in Fig. 1. Essentially a screen of electrons and ions is set up in the area at the left of the diagram, through which air-borne dirt particles pass, and in so doing pick up an electrostatic charge. The top and bottom circles at the left represent grounded rods and the solid dot between them the ionizing wire. The electrostatic field is set up between the ionizing wire and rods; air flow is from left to right. The charged particles are carried by the air until they come under the influence of the collector plates which are of opposite polarity and are represented by the horizontal parallel lines. Since unlike electrical charges attract each other, here they are drawn out of the air stream and deposited on the plate. More than 90 per cent of particles down to 1/10 of a micron are captured by this electrostatic precipitation.

The development of the Precipitron for installation in the air-conditioning system of railway passenger cars follows its widespread use for several years in industrial,

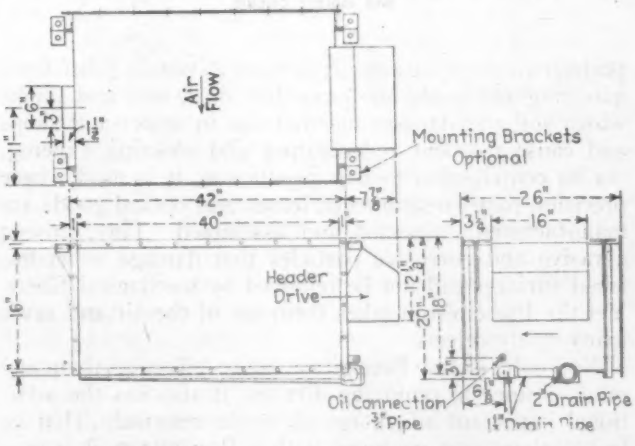


Fig. 2—Outline dimensions of a unit designed for mounting in a passenger car

commercial and domestic application. It is used, for example, to clean the ventilating air for large rotating electrical machinery in steel mills, power plants and substations. Dirt on the windings of such machines can cause excessive temperature rise or leakage over the insulation, resulting in breakdown. In telephone exchanges the Precipitron contributes to improved operation and reduced maintenance by removing the microscopic dust particles

* Transportation application engineer, Westinghouse Electric & Mfg. Company, East Pittsburgh, Pa.

which can interfere with delicate relays and thereby produce noise in the circuits. It is used for cleaning the air in pharmaceutical and chemical plants where the slightest microscopic specks cause impurities in products and imperfections in processes. It is used to obtain relief from annoying and costly air-borne dirt, dust, soot and smoke which soil and damage merchandise in stores and shops and cause frequent redecorating and cleaning expense. As its contribution to war production, it is used where precision parts, instruments, lenses and optical goods are manufactured, inspected and assembled. Tiny, unseen abrasive and corrosive particles that damage super-finished surfaces can not be removed by mechanical filters. Yet the Prescipitron takes them out of the air and saves many costly rejects.

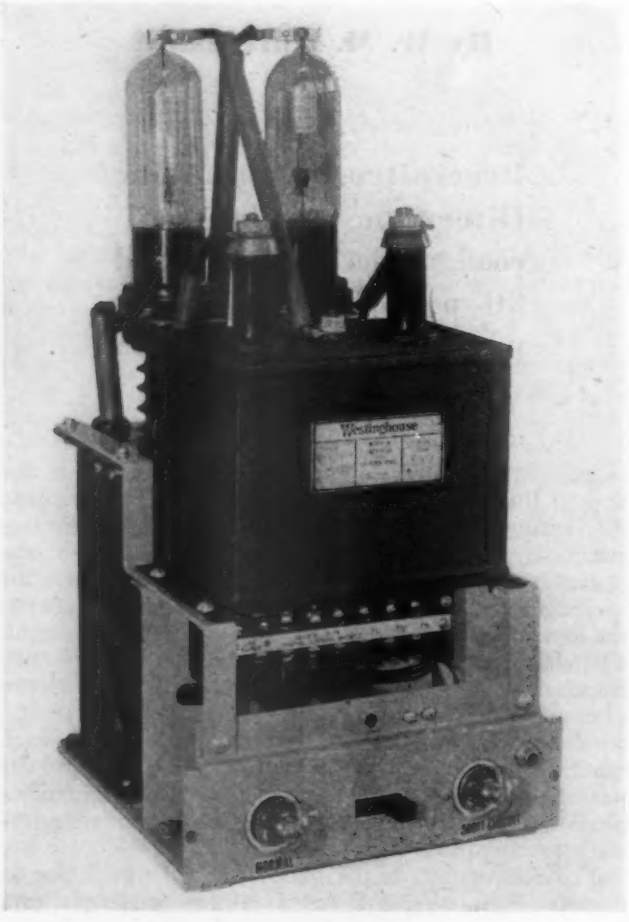


Fig. 3—Power pack used for producing current for the plate circuit and ionizer circuit

Not only is the Precipitron more effective than any other cleaner in removing dirt but it also has the additional important advantage of smoke removal. That is, in passenger cars equipped with a Precipitron, it is possible to permit indiscriminate smoking throughout the car without annoyance to passengers who do not smoke.

The introduction of the Precipitron into the field of air-cleaning rendered obsolete accepted testing methods conducted on a weight basis. These tests used an artificial dust arrangement, whereas cleaning devices are usually installed to clean normal atmospheric air. A blackness or discoloration test, therefore, provides greater accuracy, approximates the actual particle count and is made without the addition of any artificial dust. As the air is drawn through the intake of the integrating blackness tester, it passes through a filter paper placed over the intake. Provision is made for accurately measuring and adjusting the air flow. Samples of dust deposits are taken both before and after passing through the Precipitron. By comparing the time required to obtain spots of equal blackness at intake and exhaust, the efficiency of the air cleaner is determined accurately.

A comparison of the results of the weight test with the blackness test shows these interesting facts: The efficiency of the Precipitron by the weight test showed well over 99 per cent; by the blackness test 90 per cent at 300 ft. per min. Under the same test most mechanical filters are but 10 to 20 per cent efficient.

Design for Passenger Cars

Although the principle of operation of the Precipitron as applied to railway cars is the same as for commercial applications, its physical design differs radically. The commercial Precipitron is rated at a linear velocity of 300 ft. per min. for a blackness test of 90 per cent. To meet the severe space limitations of railway car application, the Precipitron must operate at a linear air velocity of 600 or more ft. per min. Under this condition, the efficiency is retained by decreasing the spacing between the collector plates and by keeping the plates well coated with adhesive. The decrease in spacing of the plates results in a corresponding decrease in dirt-holding capacity. It is obvious then that if the Precipitron can be relieved of the large particles of dust and dirt which are taken into the system of the fresh air supply, the time between successive cleaning periods of the Precipitron can be greatly extended. The best mechanical filters can do this satisfactorily; however, they become dirty and present a maintenance problem as they must be taken out of the car and either thrown away or cleaned, reoiled and replaced. If they are not well maintained, they become so clogged

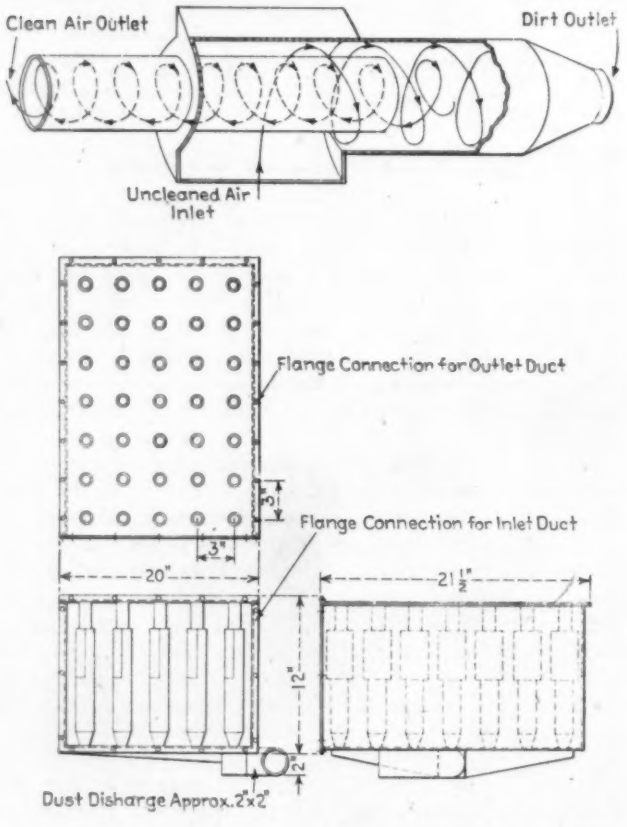
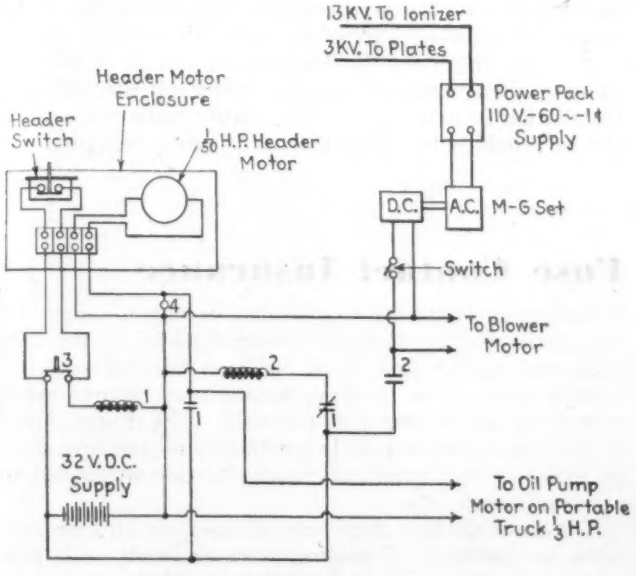


Fig. 4—An enlarged view of a vortex tube is shown at the top and a complete precleaner, including 35 tubes, is shown below

with dirt that little, if any, air passes through them. To obviate this objectionable feature the Precipitron air-cleaning system for railway cars includes a fresh air precleaner of the mechanical cyclone type. This removes heavy road dust and cinders from the fresh air stream and discharges them from the car on a continuous self-cleaning basis.

The Precipitron consists of three major parts: the dust collector cell; the ionizing unit; and the power pack. The dust collector cell and ionizing unit are assembled together in one framework. The outline dimensions of the unit with a capacity of 2,400 cu. ft. of air per min., are shown in Fig. 2. The power pack unit, mounted separately, is used to change the alternating current supply to direct current of suitable voltage to charge the ionizers and collector cells. It includes a small transformer and rectifier tubes and capacitors arranged to provide approximately 3,000 volts direct current to the plate circuit of the collector cells and 13,000 volts direct current to the ionizer circuit. Fig. 3 shows the general appearance of the power pack unit.

The precleaner is made up of a number of vortex tubes, as shown at the top of Fig. 4, which throw the dirt particles out of the air by centrifugal force and expel them from one end of the tube while the clean air passes out of the other end. Ninety-five per cent of the air which passes through the precleaner is delivered to the car interior. The remaining five per cent is used to expel the dirt particles from the cleaner and dump them overboard. Thus the Aerotec unit is self-cleaning and requires no maintenance. Fig. 4 also shows an assembly of 35 such tubes arranged for installation in the fresh air supply with a capacity of 600 cu. ft. of air per min. The assembly operates at approximately 1½ in. static pressure and utilizes a fan, operated by a ½-hp. motor.



1—Two pole s.t. 32-volt relay
2—One pole s.t. 32-volt time delay relay
3—Momentary push button switch (norm. off)
4—Red indicating light

Fig. 5—A schematic wiring diagram for railroad car application

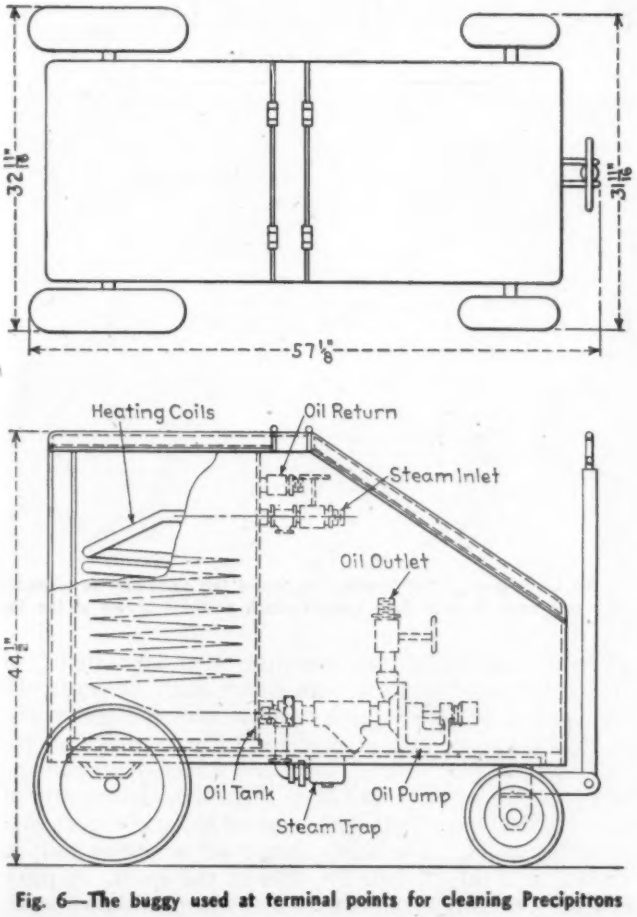


Fig. 6—The buggy used at terminal points for cleaning Precipitrons

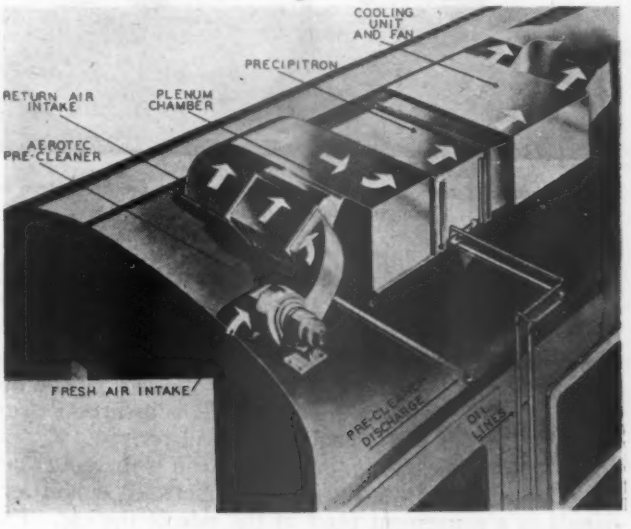


Fig. 7—Phantom drawing of a complete unit as applied to a car

The power requirements of the Precipitron itself are very moderate, totaling approximately 1/10 hp. An alternating current source is necessary to operate the power pack. This may be provided at either 110 or 220 volts by a small motor-alternator if no other source of alternating current power supply is available. A typical schematic diagram for railroad car application is shown in Fig. 5.

Periodic cleaning is necessary to remove the accumulation of dirt from the Precipitron plates. Oil is used for cleaning so that the plates are automatically coated with adhesive as they are cleaned. Two systems are available. One, the car system, provides for mounting complete cleaning equipment on each car; the other, the wayside system, provides for cleaning from wayside facilities.

The car system provides for cleaning at the throw of a switch. The Precipitron is assembled in a casing with a suitable drain. Above the plates there is a nozzle with a suitable mechanism to move it back and forth across the

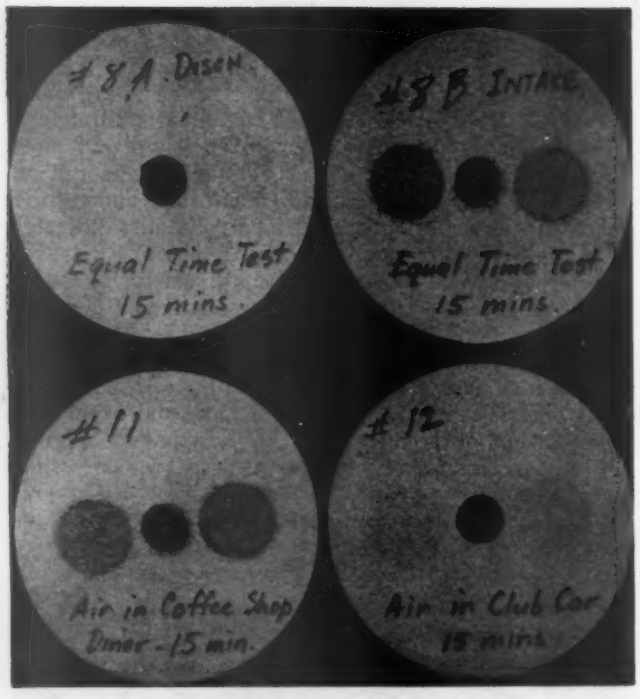


Fig. 8—Results of tests showing the effectiveness of the Precipitron in removing dust from the air

width of the Precipitron. A reservoir of oil, a motor-driven pump to circulate the oil and suitable oil feed and drain lines complete the system. An electrostatic oil cleaner is included in the oil reservoir. This cleaner removes the collected dirt from the oil and deposits it as sludge in hoppers in the bottom of the car where the sludge may be drained periodically. This assures a clean supply of oil for each flushing of the plates.

In the wayside system, the Precipitron is the same, but the oil feed and drain lines are run between it and terminals at a convenient place at the side of the car. The oil reservoir, pump and oil cleaner are built into a portable unit for movement about the car yard. To clean the Precipitron this unit is connected to the oil lines at the side of the car. After a proper interval the unit is disconnected and moved to the next car. Fig. 6 illustrates the construction of such a cleaning buggy. A skeleton view of a complete installation of a Precipitron and precleaner and horizontal air duct above the car ceiling is shown in Fig. 7.

In November, 1941, efficiency tests were made of Precipitron units in the two streamliners during a long round trip. The tests were made with the integrating blackness tester. The tests made at intervals during the trip showed an efficiency of 90 per cent or better. Other comparative tests were made during the trip by sampling air at various points. The results of two such tests are shown in Fig. 8. Each test consisted of drawing air through the filter papers for 15 minutes. Sample 8-A was taken from the clean air discharged from the Precipitron, and sample 8-B was taken from the air entering the Precipitron behind the mechanical filter in the fresh air supply. Sample 12 was taken from the air in the club car equipped with a Precipitron, and sample 11 was taken from the air in the coffee shop diner, a car which has the same type of air-conditioning system as the club car except that it was equipped with mechanical filters only. Both samples 11 and 12 were taken at a time when the cars were well occupied and many passengers were smoking. The effectiveness of the Precipitron is readily apparent as the samples show the air in the club car to be much cleaner than the air in the coffee shop diner.

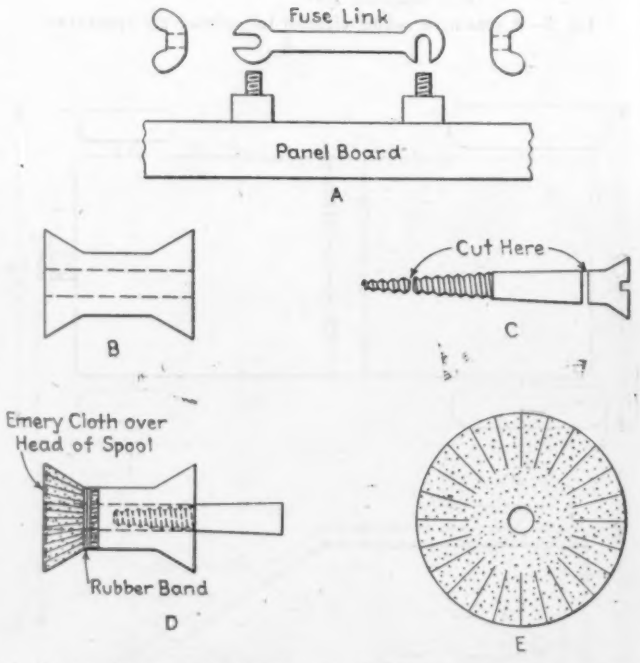
By removing the fine particles of dust which escape the ordinary mechanical filter, the Precipitron keeps the car cleaner than any other system of air cleaning, thus making possible economies in maintenance of passenger car equipment not previously obtainable. Interior finishes remain fresh and clean for extended periods as do also interior furnishings, including upholstery and window drapes when used. This assures additional comfort and attractiveness to the passenger. The application of a mechanical self-cleaning precleaner eliminates the maintenance of fresh-air filter of the oil or throw-away type.

In many instances the Precipitron can be applied to existing air-conditioned cars by modifying the air duct. Installation in new cars can be readily made since space can be provided for when the car is being designed.

Fuse Contact Insurance

If fuse contacts are loose, corroded, or out of shape, the heat generated by contact resistance added to the heat generated in the fuse itself by load current will frequently cause a fuse to blow, causing road failures, when everything else is operating properly. The device shown in the illustration was made specifically for the fuse studs on motor-control panels of Safety-Carrier air-conditioning equipment.

These panels have four sets of fuses, or 16 fuse contacts, in the form of binding posts or studs with protruding threads. Good contact is assured if surfaces are



In the lower part of the drawing are shown the parts and an assembly of a tool used to clean fuse contacts such as those shown at the top

cleaned periodically and the wing nuts kept tight. If they are cleaned by hand with emery cloth, however, the shoulder of the stud which contacts with the under side of the fuse soon gets out of shape. The assembly shown in the lower part of the sketch will effectively clean the stud contact surfaces and keep them flat. It consists of a wood screw, a small spool, a piece of emery cloth and a rubber band. The screw is cut off at either end, as shown, and turned into the hole in the spool. A piece of emery cloth is cut into a circular form, as shown at *E*,

with a hole in the center just large enough to fit over the screw threads on the studs. A number of radial cuts are made around the edge, as shown, and the emery cloth is fitted over the spool and secured by the rubber band, as shown at *D*. The screw is then chucked in a hand drill and used to clean the studs.

Coupler Cable Testing

All types of Diesel-electric locomotives, electric locomotives and multiple-unit cars employing traction motors require cables for control circuits and power circuits between motors and the car body which are subject to constant flexing. Eventually strands in these cables break, and it is desirable to make periodic tests for broken strands and thereby avoid failure.

Effective means for making the necessary tests have been developed by the New York City Transit System. These were described by B. F. Cordts, engineer, cars and shops, in a paper presented by the Transportation Group at a meeting of the American Institute of Electrical Engineers held in New York on November 14, 1944, and the following is an abstract from Mr. Cordt's paper:

Various control connections between cars are made through an automatic coupler which has three functions: one to couple the cars mechanically, two to make the air connections, and three to connect them electrically. Multi-conductor flexible cable is used between the electrical portion and the junction box on the car body. Since these cables are subject to flexing by the movement of the coupler, it has been found that wires in these control cables fatigue and finally open-circuit. There are two cables at each end of the car and each cable consists of 16 conductors, all insulated from each other. It was therefore found necessary to find some means to determine the condition of the wires in these multi-conductor cables; and since it is impossible to make a physical inspection of this cable, reliable testing equipment had to be developed.

After many unsuccessful attempts to solve the problem, the method in use at present was developed and found to do the job very satisfactorily. The circuit used is a Wheatstone bridge circuit, in which the wire to be tested from the connection in back of the coupler to the junction box forms the variable leg in the circuit, and a very sensitive light beam galvanometer across the bridge to indicate when the circuit is balanced. All the equipment is contained in the box shown on the floor, mounted on soft rubber bumpers. The light beam galvanometer is a laboratory instrument and must be protected against the rough usage ordinarily found in shops. A mechanical device is then clamped to the coupler cables and, by means of foot power exerted by the man in the pit, the cables are pulled together and separated. Under this action, if any of the strands are broken in the control wire being tested, the balance of the circuit is disturbed and an indication given on the galvanometer. This is true whether the broken strands are pulled apart by the vibration of the cable or whether they were apart originally and are closed by the vibration.

The deflection of the instrument indicates the approximate number of broken strands and, as an indication of its sensitivity, it has been possible to obtain a deflection with only 2 of the 91-28 wires, which make up some of the individual conductors broken. Certain limits of galvanometer deflections have been set to determine when a spare wire should be used in place of one with a number of broken strands.

This test is made in the general inspection period at the shop on approximately a yearly basis. Careful records are kept of each car so that the progress of the potential failure can be followed.

Procedure used for testing multi-conductor control cables

F. C. C. Proposes

Radio Channel Assignments

THE Federal Communications Commission has proposed allocations of radio channels for train communication purposes. These include (1) some joint use of channels below 3 megacycles; (2) for end-to-end communication 33 adjacent channels in the band 156 to 162 megacycles; (3) for yards and terminals, 3 bands in the television band, namely 44-50, 54-78 and 192-216 megacycles (these are to be used on an appropriate geographical sharing and non-interfering basis; (4) for experimental purposes the following: 1900-2300, 3900-4550, 5750-7050, 10500-13000, 16000-18000 and 26000-30000 megacycles. The Commission suggests that already assigned frequencies may prove practicable for the warning of wayside employes but that if they do not, three exclusive channels of appropriate width will be made available for this purpose.

Channels requested by the railroads include six below 3 megacycles, 88 between 100 and 200, 36 above 1,000, and the entire band between 2600 and 2700 megacycles. The Committee's findings are based on investigations made in the field by representatives of the Commission and on hearings held before representatives of the Commission in Washington, D. C.

On January 16, 1945, the Commission issued a report bearing the title "In the Matter of Allocation of Frequencies to the Various Classes of Non-Governmental Services in the Radio Spectrum from 10 Kilocycles to 30,000,000 Kilocycles" (Docket No. 6651). Under the subject of New Radio Services, Section 17, this report lists the proposed allocations to railroads together with a fund of data and information outlining the evidence collected and explaining the reasons for the action of the Commission. This material is summarized in the following:

The Commission is convinced that the carrier current system of operation is not, at present at least, a practicable solution for all communication needs of the railroad industry as a whole. It is felt by the Commission that the cost of installing paralleling wayside wires in locations where they are non-existent or not near track would incur an unwarranted cost; that the use of wayside wires would be impracticable in some metropolitan terminal areas, and that the system in some locations might at times be made inoperable by storms.

In The Public Interest

The Commission is convinced that a properly engineered railroad radio service will contribute to the safety of life and property both in preventing rail accidents and in reducing the seriousness of injury and damage after accidents by permitting the prompt summoning of aid to the scene of an accident.

The report states that the use of radio by the railroads should be of almost universal benefit to the public. To support this information attention is called to the fact that the railroad industry is by far the major transportation service of the nation since freight service performed by Class I railroads for the year 1943 amounted to 730,407,500,000 ton-miles, representing 86.7 per cent of all land borne freight moved in the country, while in the same year the passenger service performed amounted to 87,974,200,000 passenger miles with 891,790,000 revenue passengers carried. "Thus," the report states, "it is clear that the establishment of a railroad radio service which will contribute to the safety and efficiency of these public utilities which play so important a role in our national life will result in a direct benefit to the public."

Experiments and Applications

The testimony in the railroad radio hearing showed that radio communications could be used to advantage by all railroads, in conjunction with the present type of signaling and dispatching employed. At the time of the hearings in this proceeding, 58 separate Class II experimental stations had been authorized for experimentation in the use of radio in connection with railroad operations. Although this experimentation has been confined to about ten railroads, many more are prepared to use radio when a regular service is established for railroad purposes. Thus, on that basis, for example, 40 railroads representing 66.8 per cent of the total mileage have indicated that they will use radio for end-to-end train communication; 42 railroads representing 69.4 per cent of the total mileage have indicated that they will use radio in yard operations; and 39 railroads representing 64.3 per cent of the total mileage have indicated that they will use radio in terminal operations. Many other railroads also expressed interest in these services and it seems probable that the proposel railroad radio service will receive a very general use, once established.

Proposed Allocation

The railroads requested six channels below three megacycles. Four of these, namely, one channel at 375 kilocycles and three from 400 to 500 kilocycles were for use from ship-to-shore and in coastal harbor services. No allocations were made for these since the railroads did not request exclusive use of these frequencies. The other two were for 2318 and 2342 kilocycles to be used for emergency purposes. The railroads have not requested the use of these frequencies on an exclusive basis and the report states that adequate provision can probably be made for such emergency requirements.

In the portion of the spectrum between 100 and 200 megacycles, 88 channels were requested for railroad use. The distribution of the 88 channels requested in this band was roughly as follows: one-third for end-to-end, train-to-train and fixed point-to-train communications; one-third for communications in yard areas where freight trains are broken up and reassembled; and one-third for communications in terminal areas where interchange of cars between various railroads, industrial switching and other operations are performed by a large number of roads.

End-to-End Communication

A total of 26 channels were requested for end-to-end communication and it is the Commission's feeling that the full development of end-to-end communication service within the railroad industry will probably require the 26 channels requested.

The channels requested for use in end-to-end train communication are also to be employed in fixed point to moving train operation for communicatin between train crews and fixed point personnel in the direction of main-

line trains. In directing the movement of trains, long instructions are issued at times and, for that reason, it is necessary for the train crew to be able to "break" the director during the conversation in case of an emergency or any misunderstanding of the instructions being issued. To provide this break-in service, six channels were requested to take care of the cases where six individual railroads paralleled each other, but where this important break-in service would have to be provided on a non-interfering basis for each of these railroads. The six break-in channels, 120 kilocycles wide, were requested in the 159.12 to 159.84 megacycle band so that they would form a continuous band with the 26 end-to-end frequencies in the 156 to 159.12 megacycle band with which the break-in channels would be associated in use.

Thus, for communication between the front and rear end of trains, between trains and railway employes on the ground, between passing trains and between fixed points and trains, a total of 32 channels, 120 kilocycles wide, were requested in the band 156 to 159.84 megacycles. As previously noted, these services require interference-free channels because of the movement of trains over long stretches of country. Accordingly, it is proposed to allocate 33 adjacent channels in the band 156 to 162 megacycles. As in the case of other services in this portion of the spectrum, an average channel width of 60 kilocycles is assumed. It is further assumed that adjacent channels will not be used in the same area.

Attention is also called to the fact that the band 102 to 108 megacycles is not being assigned at this time. This makes it possible for the Commission to allocate this band at a future date to the services having the greatest need therefor, and in this connection the needs of railroad radio will be given careful consideration. Similarly, the television channel between 78 and 84 megacycles may also be available at some future date if television vacates this portion of the spectrum.

Yard and Terminal Service

For communication in yard operations 20 channels 100 kilocycles wide have been requested by the railroads in the band 133.85 to 135.85 megacycles. This request was based on the situation existing in the most congested area, the Chicago terminal district, containing 122 separate yards. Under the proposed allocation, the following frequencies in the following television bands are made available for assignment of the 20 railroad yard communications channels requested upon an appropriate geographical sharing and non-interfering basis: 44-50, 54-78 and 192-216 megacycles.

For communication in terminal operations, 33 channels each 100 kilocycles wide, have been requested by the railroads in the bands 116-116.4, 116.6-117, 133-133.8 and 137-138.7 megacycles. The estimate of 33 channels corresponds with the number of railroads operating in the Chicago terminal district. Sixteen of these railroads have asked for allocations and it is the judgment of Committee 7, Panel 13, Radio Technical Planning Board, that within a reasonably short time after the establishment of railroad radio service, all railroads operating in the Chicago district will find it desirable to utilize radio for terminal communications.

Although a wider communication range is requested for terminal operations than for yard operations—as much as 35 miles in some terminals—the localized nature of terminal operations permits the same allocation treatment to be made of the channels requested for terminal operations as has been outlined for yard communications. Accordingly, it is proposed to allocate the 33 channels requested for use in terminal operations from among the frequencies in the television bands not used in the particular areas where the terminal communications are to take place. Under the proposed allocation, frequencies in the following television bands are made available for assignment for railroad terminal communications upon an appropriate geographical sharing and non-interfering basis: 44-50, 54-78 and 192-216 megacycles.

For warning employes who must work on or near tracks, three channels 120 kilocycles wide were requested in the band 159.84 to 160.20, 20 megacycles. Since these services require only short range operation the Commission believes the railroads can safely use for this purpose frequencies allocated for other railroad services without risk of interference. For that reason the Commission does not propose to allocate any separate frequencies for this wayside warning service. If it appears that such sharing is not feasible, three exclusive channels of appropriate width will be made available.

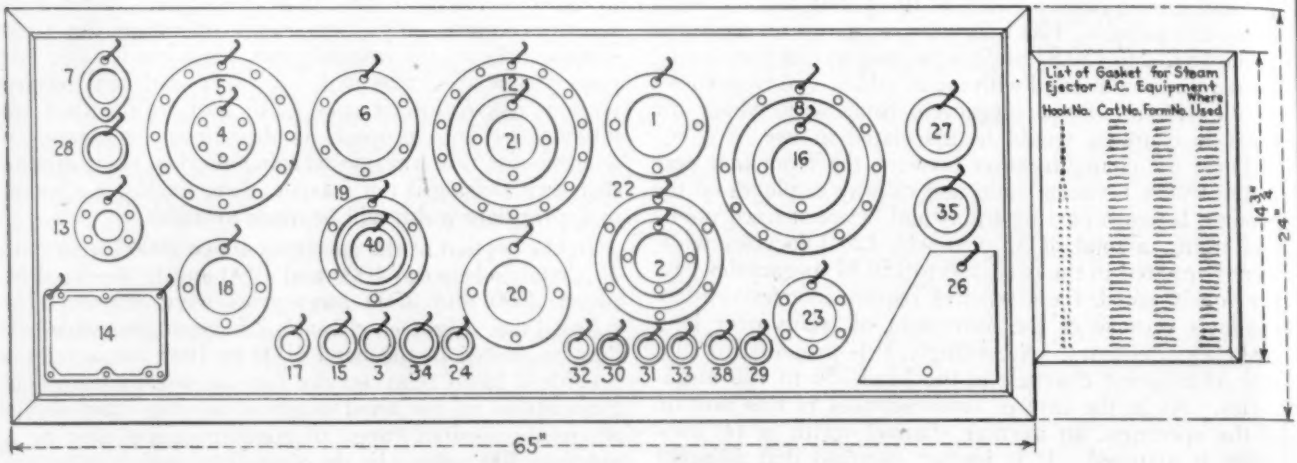
In the portion of the spectrum above 1000 megacycles, 36 channels between 1000 and 1090 and in the band between 2600 and 2700 megacycles were requested for railroad use. Eighteen channels 2.5 megacycles wide have been requested in the band 1000 to 1045 megacycles to provide a radio relay service for wayside to train communications in the fixed point to moving train service where the desired range of communication may be as much as 300 miles. In the absence of such a relay system this range of communications would of course be unobtainable at the very high frequencies (156-162 mc) proposed to be allocated to this fixed point to moving train service.

Eighteen additional channels 2.5 megacycles wide have been requested in the band 1045 to 1090 megacycles for remotely controlling centralized traffic control systems. In addition to the radio relay and remote control channels requested above 1000 megacycles, the railroad industry has requested the assignment of the entire band 2600 to 2700 megacycles for the continuation of experiments in the microwave region. The Commission is not proposing permanent assignments to the railroads in this range since there seems little possibility of obtaining equipment on a commercial basis until after the war. Experiments conducted by the Chicago, Rock Island & Pacific, however, indicate important potentialities in these frequencies, and the Commission hopes that all roads will give every consideration to further experimentation at these frequencies.

Under the proposed allocation, therefore, the following frequency bands above 1000 megacycles will be available to the railroads and others, on an experimental basis, for the development of radio relay, remote control and other services for which the 2600 to 2700 megacycle band was requested on a permanent basis, namely, 1900-2300, 3900-4550, 5750-7050, 10500-13000, 16000-18000 and 26000-30000 megacycles.

It is the opinion of the Commission that the foregoing proposed allocation for railrad radio services is adequate for all purposes. Further, it is hoped, in the light of the evidence adduced at the railroad radio hearing regarding the improved safety and efficiency facts attendant upon the use of radio in railroad operations, that the railroad industry will make the fullest possible use of the frequencies proposed to be allocated as soon as materials are available. Finally, it should be noted that it is the Commission's obligation under Section 4 (k) of the Communications Act of 1934, as amended, annually to "report to the Congress whether or not any new wire or radio communication legislation is required better to insure safety of life and property." In conformity with that obligation, the Commission will continue to study the progress made

by the railrads in the application of radio to their operations. Therefore, although the issuance of this proposed report in this proceeding, Docket No. 6651, looks also to a conclusion of the Commission's docket proceeding No. 6593,* the Commission will, if necessary, hold further hearings on the subject of the application of radio to railroad operations.



Air-conditioning gasket and identification board

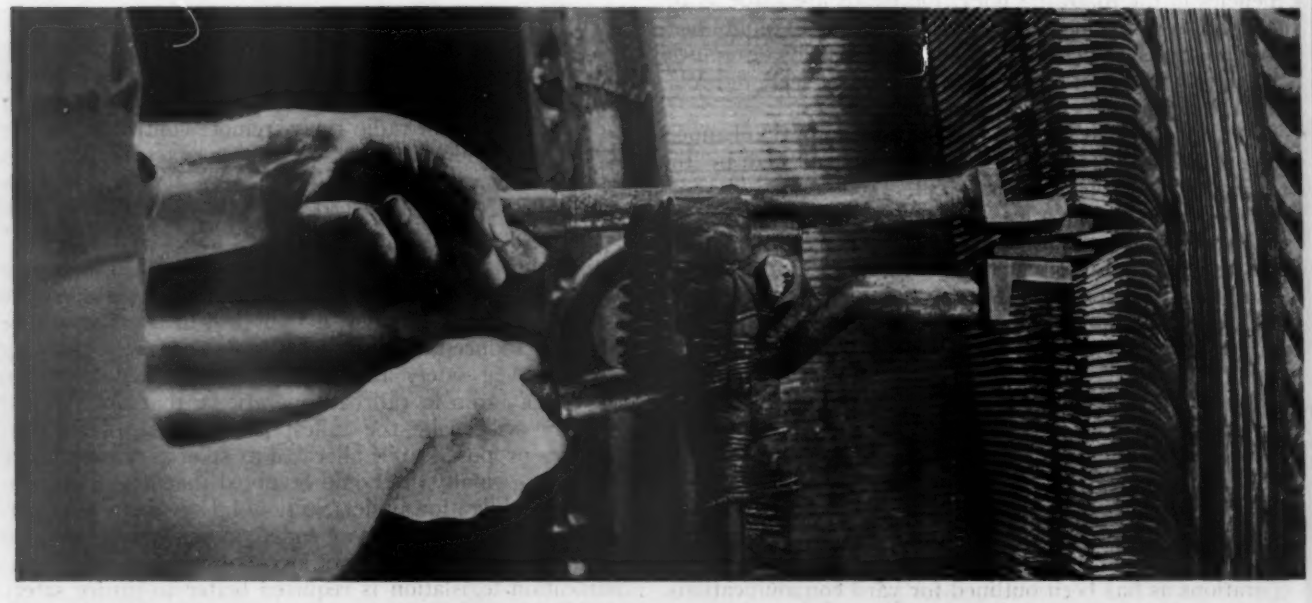
Gasket Board

A wide variety of gaskets are used on Safety-Carrier steam jet air-conditioning equipment for passenger cars, some of the gaskets being very similar in appearance to others. It is important that gaskets be applied where intended and only factory-cut gaskets should be used. Unless this is done, slow vacuum leaks which are difficult to locate, will develop and will lower the efficiency of the equipment.

To insure a complete supply of factory-cut gaskets at all times, so arranged that the maintenance man may quickly identify the gasket required, a board was made up, as shown in the illustration.

At the right-end of the board there is a key list, the contents of which are taken from the manufacturer's catalogue. This enables the maintenance man to refer to the list and find the proper gasket, or if he recognizes the gasket on the board he may note the hook number and refer to the list for proper identification for charging it out. By having the gaskets arranged as shown a low or depleted stock is quickly noted and additional gaskets ordered.

* * *



Hand-operated tongs as used for phos-copper brazing of coil terminals on a large d. c. generator—Where space permits, this process insures good connections—Melting temperature of phos-copper is 815 deg. C. (Photo courtesy of Westinghouse Electric & Mfg. Company)

* Simultaneously with the issuance of this proposed report in Docket proceeding No. 6651, an order is being issued in Docket proceeding No. 6593 providing that portions of this report dealing with the railroad radio service shall be deemed the Commission's proposed report in Docket 6593. Copies of that order and of this report are being served on all parties who appeared in Docket 6593.

(*Turn to second left-hand page*)

7 RIGID TESTS FOR CHILLED CAR WHEELS

The Code of Practice of the Association of Manufacturers of Chilled Car Wheels, ensures the railroads of a dependability of product so important where safety, economy and long life are basic factors of operation.

"The 7 Rigid Tests for Chilled Car Wheels" is just another "double check" to guarantee the maintenance of these superior quality standards of Chilled Car Wheels.

Test No. 5

The Thermal Test

The object of the Thermal Test is to demonstrate the ability of the wheel to withstand temperature stresses encountered in service due to brake application.

THE 7 RIGID TESTS THAT GUARANTEE UNIFORMITY

1. Chill test block taken at least once in every ten wheels poured.
2. One complete chemical analysis with each heat.
3. Constant pyrometer checks for accurate processing temperature.
4. Drop test of finished wheel (A.A.R. Specifications).
5. Thermal test of finished wheel (A.A.R. Specifications).
6. Test for Rotundity.
7. Brinell Hardness test for maximum and minimum chill limits.

Method of making Thermal Test

One of the great outstanding performances of the war has been the contribution of the Railroads of America.

3856

ASSOCIATION OF MANUFACTURERS OF CHILLED CAR WHEELS

230 PARK AVENUE, NEW YORK, N. Y. • 445 NORTH SACRAMENTO BOULEVARD, CHICAGO, ILL.

Organized to achieve: Uniform specifications — Uniform inspection — Uniform product

NEW DEVICES

Lift Truck for Handling Car Wheels

An attachment for handling car wheels which fits the standard fork-type truck which is manufactured by the Baker Industrial Truck Division of the Baker-Raulang Company, Cleveland, Ohio, is now available. The attachment consists of a hinged hoe-like clamp which engages the top of the end wheel of a load on the truck fork. This clamp arm is raised to clear the wheels by a lever and may be latched in the raised position while the fork is run under wheels which are to be moved. The clamp is then lowered and the wheels are locked in position on the fork.

A lift truck equipped with a fork attachment and clamp for handling unmounted car wheels

A truck of 6,000 lb. capacity will handle from one to six wheels on its 48-in. fork. When less than six wheels are to be carried, a pin stop on the clamp arm prevents them from tipping. Wheel diameters up to 36 in. can be carried. It is also possible to carry a capacity load of axles or two axles with wheels mounted on the truck fork without removing the clamp arm. An interchangeable boom attachment can be furnished for use in handling wheels into and out of gondola cars.

Train Protection Lights

Several lights for use by trains which have been derailed, stopped unexpectedly or for signaling to approaching trains have been developed by the Mars Signal-Light Co., Chicago. One of these lights, designated WR-5000, for use on high-speed passenger trains, produces a 500,000 candle power beam of white light which oscillates in the form of a horizontal figure eight and which can be changed to a red beam when necessary. The white light serves as a warning at grade crossings and the red one may be used by the engineer in the case of an emergency which may obstruct the opposite main track. The second headlight, available for locomotives other than high speed which do not require the white light, is made up with a red-beam projector only. A third lighting unit for protecting the rear end of trains produces a powerful red beam which does not oscillate.

The headlight for high-speed trains has two fixed outer reflectors and a movable 10-in. parabola reflector in which is mounted a 40-amp., 12-volt lamp. There are two such reflectors placed at an angle of 90 deg., one having a red lens for use as a distress or warning light. The reflectors are caused to oscillate by a 40-watt, 12-volt, 6,000 r.p.m. motor which is reduced to 8 r.p.m. on the oscillator shaft by a reduction gear. The control switch allows for bright, dim, and emergency red positions. There is also a push-button switch for inching the light to a fixed position such as for use on curves.

The headlight for use on freight or lower-speed trains employs a standard 250-watt, 32-volt locomotive headlight lamp in a 12-in. parabolic reflector. It produces a red oscillating beam of 350,000 candle power. The driving motor is rated 84 watts and 32 volts. The lights are furnished with pressed-steel cases for use on Diesel-electric locomotives and for steam locomotives a cast-aluminum case is used.

Protective Coating For Spray Booth Walls

Triad PR, a new protective coating for the sidewalls of both wet and dry spray booths, is announced by Detrex Corporation, Detroit 27, Mich. With this new coating between the walls and the layer of overspray that normally builds up, quick and easy cleanup is obtained. The booth so protected is stripped clean simply by spraying with water or steam; the Triad PR and accumulated paint flush off together. In dry booths which have no drainage facilities, the protective coating greatly facilitates scraping off the paint. The new protective coating can be applied by either brush or spray gun. It is said to give excellent coverage, and to dry to a hard, white, dustless coating which improves visibility in the booth.

Silicone Insulating Resins

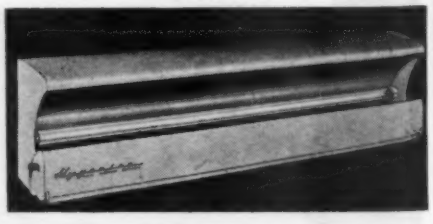
Silicones, a new class of organo-silicon insulating materials are now in commercial production by Dow Corning Corporation of Midland, Mich. These products have exceptional heat stability, resistance to moisture and freedom from carbonization at high operating temperatures. They are, therefore, natural complements to inorganic spacing insulation such as Fiberglas, asbestos and mica.

Several types of Dow Corning insulating resins have been under development, each designed for a specific use requirement. One of these resins, represented by Dow Corning 993 is employed as an impregnant and coating for Fiberglas served magnet wire and for woven Fiberglas electrical tapes, cloth and sleeving. It requires high temperatures to cure to a tack-free state; 1 to 3 hours at 250 deg. C. or shorter times at 350-400 deg. C. This combination provides flexible continuous insulating constructions which withstand long operating temperatures of 150 to 200 deg. C. in electrical equipment. A third type, represented by resin No. 2052, is intended as an impregnant and thermosetting dielectric for rotating parts of electrical equipment. On baking at 200 deg. C., it sets throughout its cross-section to a relatively hard resin which does not flow. It was designed primarily to be resistant to centrifugal displacement in parts of electrical equipment rotating at high speeds and at elevated temperatures.

Since these new organo-silicon resins permit operating temperatures at which paper, cotton and other organic insulations carbonize, they are not recommended for use with such materials. Because these insulating resins make possible higher safe operating temperatures, they permit the design of electrical equipment of increased power output, decreased size and weight and improved reliability. When electrical equipment of present design is insulated throughout with Silicone in conjunction with all inorganic spacing materials, a wider margin of safety from overload failures is obtained due to the heat stability and moisture proofness of the resins.

Germicidal Lamp

American Sterilizer Company, Erie, Pa., has recently placed on the market a new model of its Hygeaire germicidal lamp units for air disinfection. It differs from the original model in its shape and general appearance—the result of its having been streamlined and made more attractive. The unit employs a G-E germicidal lamp to project intensified ultraviolet rays across living or working areas above eye level. A scientifically designed reflector provides both optimum intensity and diffusion of the rays that are lethal to air-borne bacteria. The unit may be recessed into the wall, or wall or ceiling suspended. It is being offered to assist in combating absenteeism caused by cross-infection in offices and plants. Distribution is being made through The Graybar Electric Company and General Electric Supply Corporation.



Streamline Hygeaire lamp

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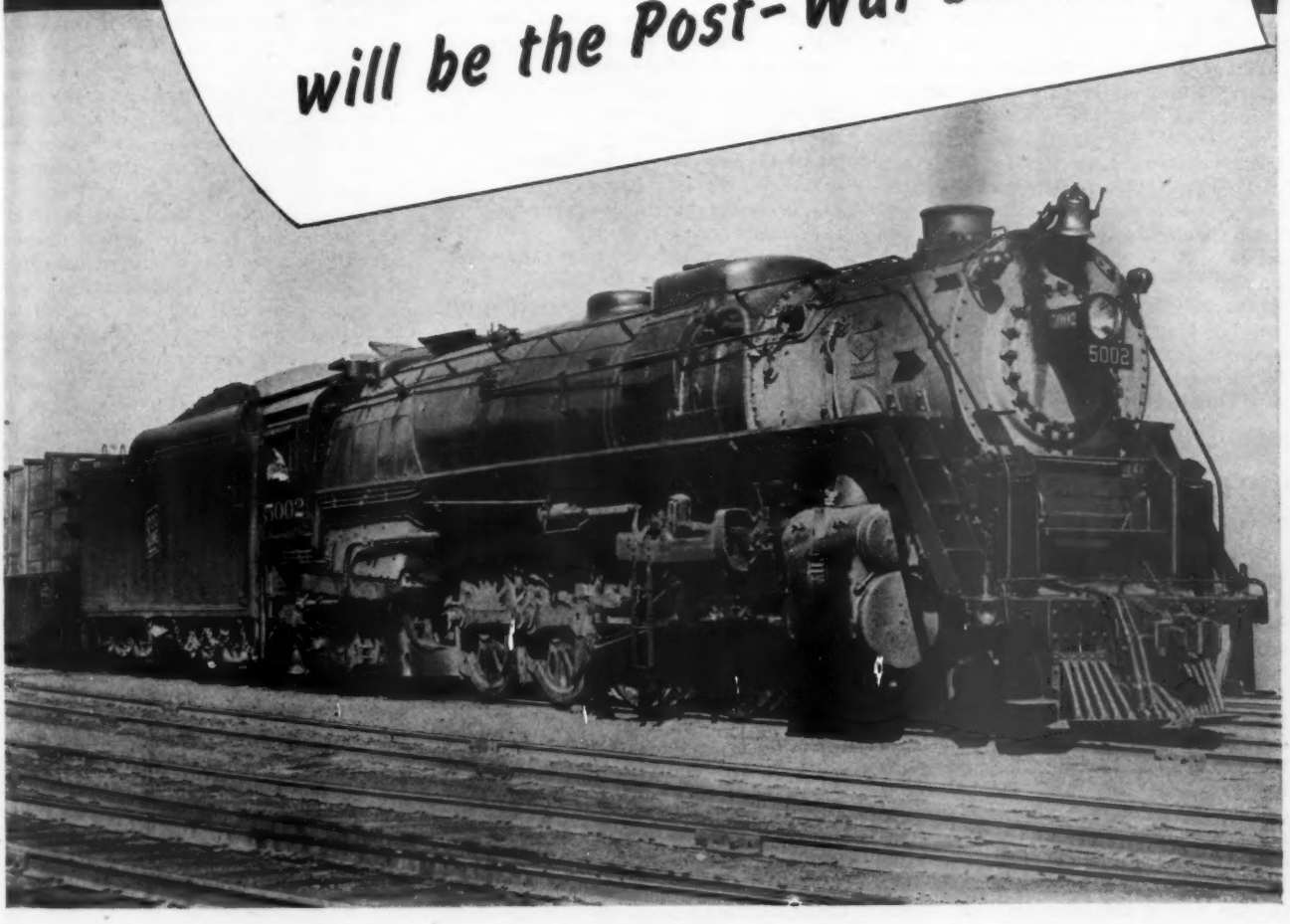
STILL FASTER TRANSPORTATION will be the Post-War Demand



To meet the post-war transportation problem of moving freight both more rapidly and more economically, modern equipment will be an absolute essential.

The most efficient type of motive power will be needed—steam locomotives that can haul heavy trains at high speeds on long runs.

Lima Super-Power 4-8-4s are built for just such work and have already thoroughly proved their capacity for maintaining exacting schedules in the handling of both freight and passenger traffic.

LIMA LOCOMOTIVE WORKS INCORPORATED

LIMA LOCOMOTIVE WORKS INCORPORATED, LIMA, OHIO

NEWS

No Mechanical Division Meeting in 1945

In view of the present status of the war emergency and the request of the Office of Defense Transportation that all conventions not absolutely necessary to the war effort be deferred, it has been decided not to hold an annual meeting of the A. A. R. Mechanical Division or the Electrical Section of the Mechanical Division during the year 1945. Executive Vice-Chairman V. R. Hawthorne, in making this announcement, stresses the importance of no letup, but, in fact, increased attention to matters concerning safety and equipment maintenance. He says that arrangements will be made, as in the case of previous non-meeting years, to carry on the various activities of the Division relating to these and other important matters by means of correspondence supplemented by such group and committee meetings as may be necessary.

First Baldwin Road Diesel Tested on the B. & O.

A high-speed Diesel-electric locomotive in the design of which knowledge gained from wartime railroad operations has been incorporated was on trial during the week ended January 20 on the Baltimore & Ohio between Baltimore, Md., and Washington, D. C. The locomotive, the first road type for through service built by the Baldwin Locomotive Works, in collaboration with the Westinghouse Electric & Manufacturing Company, has two 1,000-hp. eight-cylinder Diesel engines, mounted fore and aft. These engines and the electrical facilities are similar to those in Baldwin-Westinghouse switching and transfer locomotives now in extensive use. The underframe, trusses, and sides of the locomotive are welded together to form the equivalent of a single piece of rigid steel which it is expected will provide greater resistance to impact and a minimum of vibration. The cooling system for the engines is thermostatically controlled. Although designed primarily to pull freight trains at high speed, the locomotive handles passenger trains also and is said to perform equally well forward or backwards.

Special arrangements were made with the B. & O. to use its facilities for the test. Charles E. Brinley, chairman of the board of directors of the Baldwin Locomotive Works, rode in the cab of the locomotive on its first trip. It made three round trips daily during its trial.

A twin unit is now under construction. Coupled together, the two units can form a 4,000-hp. locomotive where high capacity is needed.

Diesel Locomotive Assignments Changed on Southern

In a story beginning on page 549 of the December, 1944, issue of the *Railway Mechanical Engineer* about Diesel locomotive repair facilities on the Southern, locomotive assignments were described which have since been changed. When the story was prepared Diesel locomotives were accumulating most of their between-shoppings mileage in relatively short shuttle runs. At the present time locomotives are dispatched from the shops at Chattanooga, Tenn., in either one of two services. One of these comprises a run from Chattanooga, Tenn., to Cincinnati, Ohio, to New Orleans, La., to Chattanooga, for a total mileage of approximately 1,700. The other service is between Chattanooga and Louisville, Ky., in which three round trips are made for a total mileage of approximately 1,900. This change in locomotive assignments has not altered the shop scheduling of repairs.

Steam Locomotive Study Launched by Railroad and Coal Companies

A new research project to improve the coal-burning locomotive has been launched jointly by six coal-originating railroads and three major coal producing companies. Plans were formulated at a meeting at the Biltmore Hotel, New York, on January 12, which was attended by the presidents of the six railroads; representatives of the coal companies; Karl Compton, president of the Massachusetts Institute of Technology, and Dean A. A. Potter of Purdue University. More than $1,000,000 has been subscribed to initiate research which will be handled by Bituminous Coal Research, Inc., as a distinct project with separate personnel and administered by the following locomotive development committees: R. B. White (chairman), president, Baltimore & Ohio; W. S. Franklin, vice-president, traffic, Pennsylvania; J. B. Hill, president, Louisville & Nashville; W. J. Jenks, president, Norfolk & Western; G. Metzman, president, New York Central; C. E. Newton, president, Chesapeake & Ohio; J. D. Francis, president, Island Creek Coal Company; G. M. Humphrey, president; M. A. Hanna; G. Stauffer, president, Sinclair Coal Company, and Dr. H. J. Rose, director of research, Bituminous Coal Research, Inc.

H. N. Eavenson, president of Bituminous Coal Research, in announcing the new project, said that although important recent improvements in coal-burning locomotives have been made by railroads and manufacturers and numerous other designs are known to be under active study, the existing developments will not be duplicated by this new project. The contributing companies were said to believe that the latest advance in science and en-

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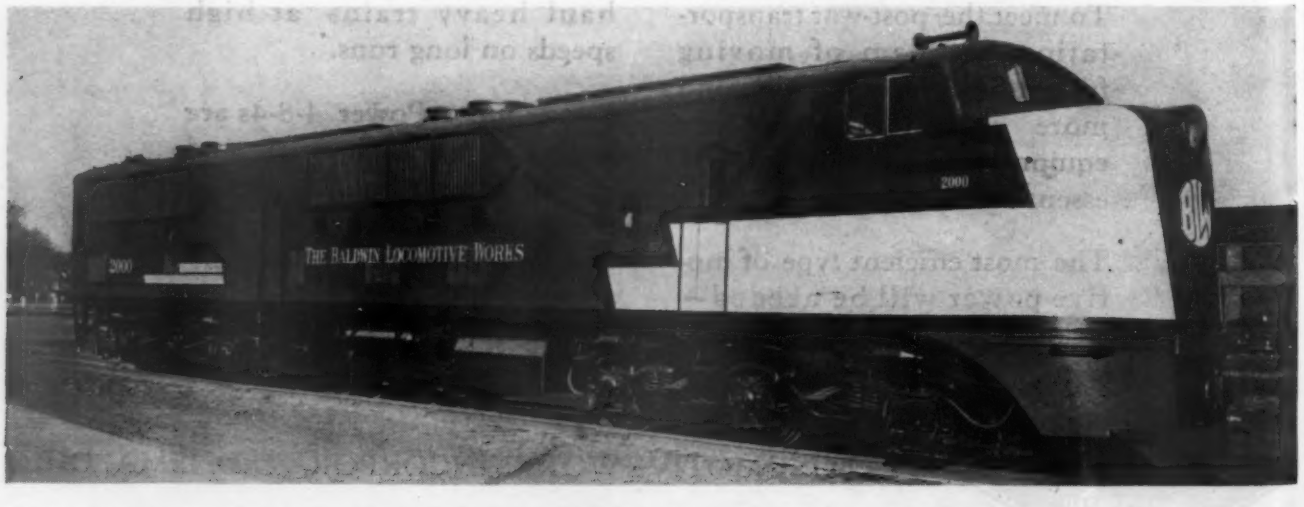
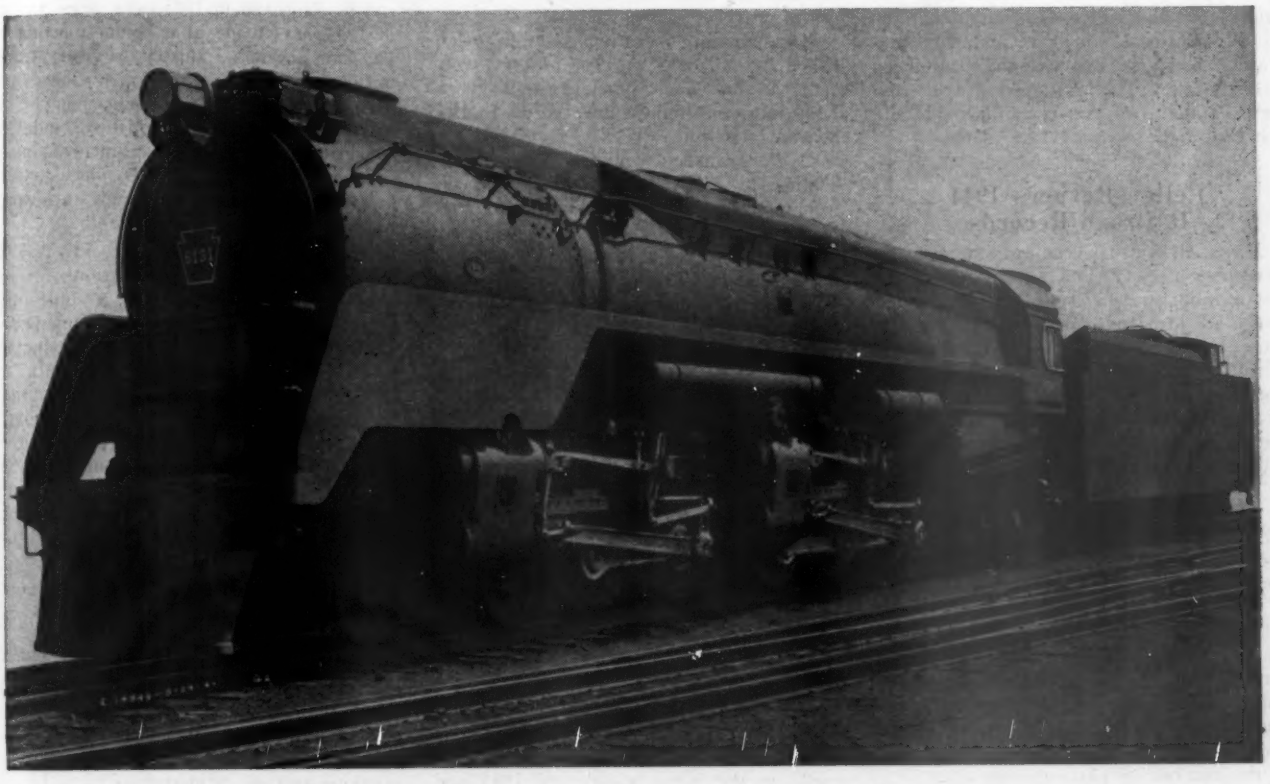


The first 2,000-hp. Diesel-electric road locomotive built by the Baldwin Locomotive Works, in collaboration with the Westinghouse Electric & Manufacturing Company

Pennsylvania Railroad's ... New Fast Freight Engine



This Wartime Giant, P.R.R. Class Q-2, with its tender, built by the Pennsylvania Railroad, tips the scales at more than a million pounds. Overall length of the locomotive and tender is 124 feet 7 inches; its height is 16 feet 5 inches. The engine develops starting tractive effort (pull exerted on a standing train) of 114,860 pounds. High pulling power is maintained up to 70 miles an hour.

These Locomotives are equipped with the new TYPE E Locomotive Boosters.*

*Trade Mark Reg. U.S. Pat Off.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK • CHICAGO

In Canada: FRANKLIN RAILWAY SUPPLY COMPANY, LIMITED, MONTREAL

gineering will permit other newer improvements to be made in the use of coal for railroad motive power, which may be revolutionary.

Mr. Eavenson pointed out that the U. S. Bureau of Mines statistics show that 98.9 per cent of the estimated natural fuel reserves of this country are in the form of coal—enough to last for more than 3,000 years. "It is therefore evident," he said, "that the railroads should continue to rely on coal which is abundant and cheap and which is commercially produced in 27 states. The continued growth and future stability of American railroads and the coal industry are inter-related."

Pelley Reviews 1944 Railroad Records

MAKING his usual year-end statement on December 29, J. J. Pelley, president of the Association of American Railroads, noted that "all previous transportation records were broken in 1944 by the railroads" when they handled, "without serious transportation difficulties," the "greatest volume of freight and passenger traffic in their history." Mr. Pelley's statement continued as follows:

"Freight traffic moved by the railroads in 1944 amounted to approximately 740 billion ton-miles. This was 1.8 per cent above that for 1943, the previous record, and two and one-fifth times the number of ton-miles moved in 1939.

"Railroads handled this enormous traffic load in the current year with virtually the same number of locomotives and with hardly more than a nominal increase in the number of freight cars compared with 1939. There also was only a slight increase in the number of passenger cars.

"Freight carloadings in 1944 totaled approximately 43,500,000 cars, or an increase of 2.5 per cent above the preceding year. The increase in the number of freight cars loaded and longer hauls per ton accounted for the increase in the ton-mile volume of freight.

"Passenger traffic in 1944, too, was by far the greatest for any year in railroad history. It amounted to 96 million passenger-miles. This was an increase of 9.3 per cent above 1943, and four and one-fifth times what it was in 1939. This unprecedented movement of passengers in 1944 resulted in part from Army troop movements, more than 10,700,000 men having been moved in special trains and special cars alone. This number does not include the millions of soldiers, sailors, and marines on furlough who traveled during the year, nor does it include small groups of individuals moving on order, nor Navy and Marine Corps movements, nor prisoners of war.

"Outstanding operating records established by railroads in 1944 follow:

"1. Average load of freight per train was 1,144 tons, the highest on record. In 1943 it was 1,116 tons.

"2. Performance per train more than doubled in 20 years, gross ton-miles per freight train hour having increased from 18,257 in 1924 to 37,548 in 1944, while net ton-miles per freight train hour increased from 8,222 in 1924 to 17,745 in 1944.

"3. Average daily movement of active freight cars was 52.8 miles in 1944 compared with 52 miles in 1943.

"4. Average haul of freight was 478 miles in 1944, compared with 469 miles in 1943.

"5. The average number of passengers per car and per train was much greater than ever before.

"6. Average revenue for hauling a ton of freight one mile was 0.942 cents compared with 1.116 cents twenty years ago.

"7. Average capacity of freight cars was 50.9 tons at the end of 1944, the highest on record.

"8. Tractive power of steam locomotives averaged 53,000 pounds, the highest ever recorded and an increase of 33 per cent compared with twenty years ago.

"There was a noticeable leveling off in traffic in the latter months of 1944 and present indications are that the record high mark in the volume of both freight and passenger traffic has been reached.

"From a financial standpoint, the results in 1944 have not been as satisfactory as in previous years. While gross revenues have continued to follow the line of increasing traffic, the peak in net earnings was reached in 1942 and has been declining since then. Gross revenues in the current year were more than two billion dollars higher than in 1942 but net railway operating income was off $340 million dollars. This has been due to higher wages and taxes and to increased cost of materials and supplies. Since the beginning of the present war, these costs, other than taxes, have increased by more than 25 per cent."

1945 Car Schedules Cut Sharply

A PREDICTION that freight-car production can be improved in 1945 over rates current in 1944, was made at a recent meeting of the Car Builders Industry Advisory Committee of the War Production Board, according to a W.P.B. announcement. This increase can be accomplished, industry spokesmen said, if the government claimant agencies and the railroads place orders properly spaced and far enough in advance to assure continuous production.

It was reported that present W.P.B. schedules call for the production of some 41,000 freight cars in 1945, a substantial decrease from the 1944 output. During the first eleven months of 1944 production averaged about 5,800 cars a month, although in three recent months, the average had dropped to about 5,300 cars per month. Over the 11-month period the monthly output was 4,600 cars from contract shops and 1,200 from railroad shops, but during the three months referred to the contract shops were averaging 3,800 cars and the railroad shops, 1,500.

This gain on the part of railroad shops, as compared to independent builders, was explained at W.P.B. as probably due to continuity of work at their shops. Under the quota system, it was pointed out, carriers' shops have produced about 16 per cent of total freight-car production during the past two years, as compared with a previous average estimated as 12 to 14 per cent of the total.

What was described as a new over-all policy setting a ceiling for future non-military production based on actual production in the fourth quarter of 1944 was outlined to the committee by W.P.B. executives. Even if there should be cutbacks in military requirements, non-military claimants would be allowed to absorb such released productive capacity only after a special survey of the manpower supply in affected labor areas. It is the purpose of the W.P.B. to make sure that skilled labor needed for war production will not be used for such non-military production, according to this explanation.

Present available estimates would allocate the expected 1945 freight-car production as follows: War Department, 5,000; Navy Department, 600; Foreign Economic Administration, 3,000; Office of Civilian Requirements, 103; W.P.B. Steel Division, 239; leaving the remainder, or around 32,000 cars for the Office of Defense Transportation, through which railroad allocations are handled. The industry committee was told by Brig. Gen. Charles D. Young, O.D.T. deputy director, that third-quarter production may be concentrated on box cars. No prospect was developed in the committee meeting that authorizations for domestic railroad passenger car production in 1945 would go beyond a "very small number," because of the continued critical manpower situation.

Orders and Inquiries for New Equipment Placed Since the Closing of the January Issue

LOCOMOTIVE ORDERS

Road	No. of locos.	Type of loco.	Builder
Kentucky & Indiana Terminal	10	1,000-hp. Diesel-elec.	Baldwin Loco. Wks.

FREIGHT-CAR ORDERS

Road	No. of cars	Type of car	Builder
Atchison, Topeka & Santa Fe	500[1]	50-ton box	Mt. Vernon Car Mfg. Co.
Baltimore & Ohio	500	50-ton auto-box	Greenville Steel Car. Co.
Bangor & Aroostook	100	40-ton box	Magor Car Co.
Chicago & Eastern Illinois	500	50-ton hopper	Pullman-Standard
Colorado & Wyoming	50	70-ton ballast	American Car & Fdry.
Great Northern	500	50-ton gondola	Pressed Steel Car
	250	70-ton flat	American Car & Fdry.
New York, New Haven & Hartford	500	Box	Pullman-Standard
Northern Pacific	500	Box	American Car & Fdry.
	500	Box	Pullman-Standard
Seaboard Air Line	500	50-ton box	Pullman-Standard
	300	50-ton flat	Bethlehem Steel Co.
Southern Pacific	500[1]	50-ton box	Mt. Vernon Car Mfg. Co.
Toledo, Peoria & Western	50	50-ton box	Pullman-Standard
Union Pacific	1,000[1]	50-ton box	Mt. Vernon Car Mfg. Co.
Western Maryland	100	50-ton box	General American Trans.

FREIGHT-CAR INQUIRIES

New York Central	1,000[2]	70-ton gondola	
St. Louis-Southwestern	25	70-ton covered hopper	

[1] For third-quarter delivery.
[2] For the Pittsburgh & Lake Erie.

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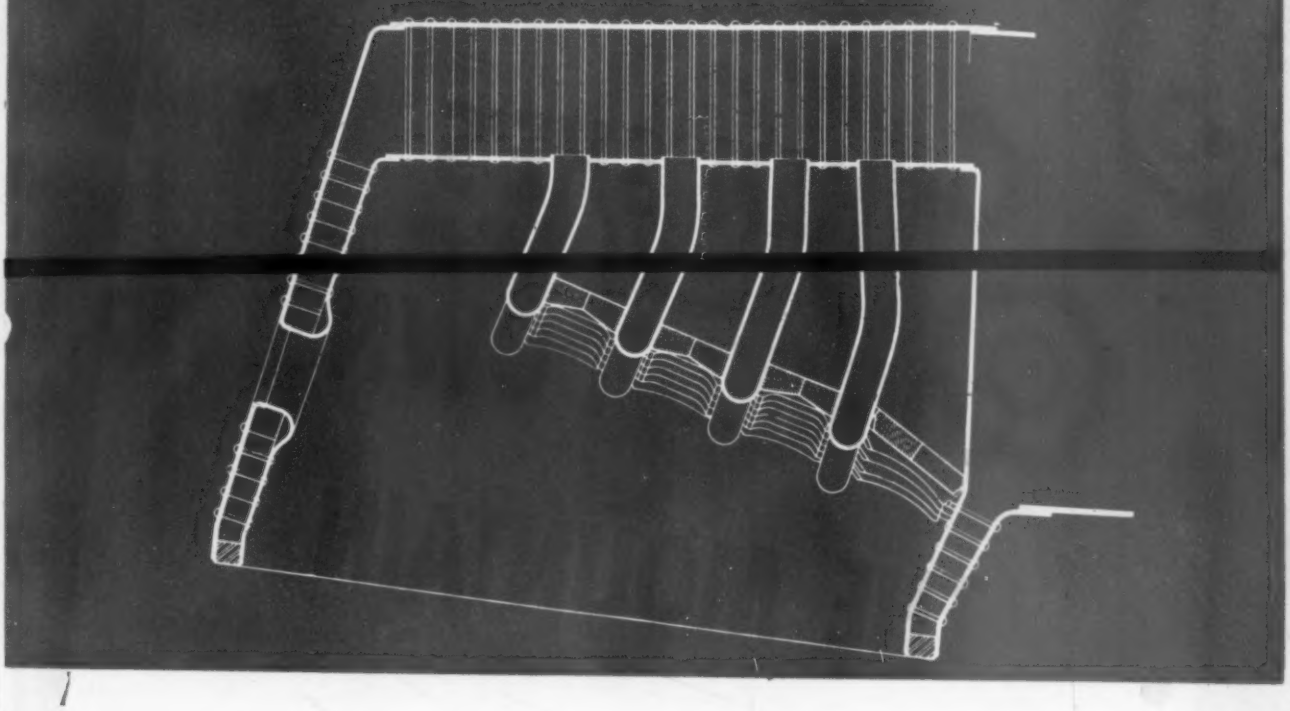
TO SAFEGUARD THE ENTIRE CROWN SHEET



THE installation of Security Circulators assures a positive flow of water over the crown sheet at all times. To give complete protection the Security Circulators should be adequate in number and suitably spaced from the flue sheet to the door sheet.

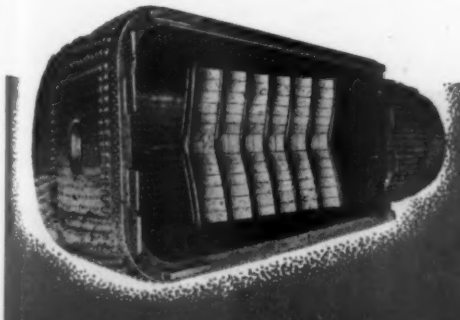
OTHER OUTSTANDING ADVANTAGES

Security Circulators are adaptable to any type of locomotive and to any size of firebox.

They increase the strength of the firebox structure and help to prevent boiler distortion.

They form an ideal support both for crown sheet and arch brick, and permit the use of a 100% arch in any type of firebox.

The installation of Security Circulators makes locomotives available for continuous operation over longer periods of time. Such locomotives have better combustion and longer arch life with less flue plugging and less cinder wear, so that a minimum of boiler maintenance is required.



AMERICAN ARCH COMPANY, Inc.

NEW YORK • CHICAGO

SECURITY CIRCULATOR DIVISION

IT'S A GREAT NEW DAY FOR RAILROADING

WHEN SHE'S COMING DOWN THE MOUNTAIN

GENERAL MOTORS
LOCOMOTIVES

—or rolling on the plain,
the electric retarding brake in
General Motors Diesel
freight locomotive
does an important job:

It enables heavy loads to take
steep grades safely and in faster time
without stops for cooling the wheels,
and few for setting retainers.

It saves much time in flat country
when making slowdowns;
the electric retarding brake can be
released quickly at any speed.

ON TO FINAL VICTORY ★ BUY MORE WAR BONDS

ELECTRO-MOTIVE DIVISION
GENERAL MOTORS CORPORATION · LA GRANGE, ILL.

Supply Trade Notes

WORTHINGTON PUMP & MACHINERY CORPORATION.—*Clarence E. Searle* has been elected president of the Worthington Pump & Machinery Corporation to succeed *Harry C. Beaver*, who becomes vice-chairman of the board of directors and chairman of the management committee. Mr. Beaver had

Clarence E. Searle

been president of the corporation since 1931, and Mr. Searle had been vice-president in charge of sales since joining the Worthington organization in 1932, following a long period of service in various executive capacities with the Allis-Chalmers Manufacturing Company of Mil-

Hobart C. Ramsey

waukee, Wis. *Hobart C. Ramsey*, vice-president in charge of operations, has been elected executive vice-president; *Edwin J. Schwanhausser*, vice-president in charge of manufacturing and sales operations in Buffalo, N. Y., has been elected vice-president in charge of sales, and *Leslie C. Ricketts*, manager of the Harrison, N. J., works, has been elected a vice-president.

◆

GENERAL ELECTRIC COMPANY.—*David C. Prince*, vice-president of the General Electric Company, has been appointed in charge of the company's general engineering laboratory, the activities of which will be broadened to include the requirements of the entire company.

◆

AMERICAN BRAKE SHOE COMPANY.—*William T. Kelly, Jr.*, general purchasing agent for the American Brake Shoe Company, has been appointed executive vice-president of the company's Kellogg division. Mr. Kelly will continue also his duties as general purchasing agent.

◆

AMERICAN LOCOMOTIVE COMPANY.—*L. S. Peabody* has been appointed eastern district sales manager for steam and Diesel locomotives for the American Locomotive Company to succeed *A. K. Auburn*, who has resigned. Mr. Peabody also will retain all of his present duties as district sales man-

L. S. Peabody

ager of the company's Railway Steel-Spring Division. He began his career with the Western Electric Company where he remained for a few years and then transferred to the Burnet Company as a salesman of mill and electrical supplies for the railroad equipment field. He joined the sales force of the Railway Steel-Spring Company in 1909 and later was appointed New York district sales manager, which position he continued to occupy after the consolidation of the Railway Steel-Spring Company with the American Locomotive Company. Mr. Peabody subsequently was appointed district sales manager of that division.

◆

PITTSBURGH STEEL FOUNDRY CORPORATION.—*Thomas F. Dorsey*, sales manager of the Fort Pitt Steel Casting Company, has joined the Pittsburgh Steel Foundry Corporation, Glassport, Pa., in a special representative capacity.

Army-Navy "E" Awards

Leslie Company, Lyndhurst, N. J. Fourth renewal. The Maritime "M" has also been presented to the company.

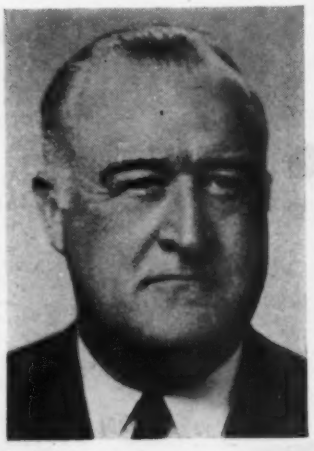
FLANNERY BOLT COMPANY.—*W. S. Kirkpatrick* has been appointed assistant to the president of the Flannery Bolt Company, Bridgeville, Pa., with headquarters in New

W. S. Kirkpatrick

York. Mr. Kirkpatrick was formerly associated with the management firm of Houston & Jolles of New York and was vice-president of the A. O. G. Corporation of Providence, R. I. Previously he was contract officer for the British Purchasing Commission, following several years in Europe on special assignment for the International Telephone & Telegraph Corp.

◆

UNITED STATES RUBBER COMPANY.—*James E. Power* has been appointed eastern sales manager of the mechanical goods division, United States Rubber Company. Mr. Power began his rubber career in 1906 as an office boy. Five years later he



Pach Bros., N. Y.
James E. Power

became a salesman, and in 1926 he was appointed manager of the New York branch of the mechanical goods division. He interrupted his career during World War I to join the United States Navy. He returned to his post in 1919, and later became assistant manager of branch sales.

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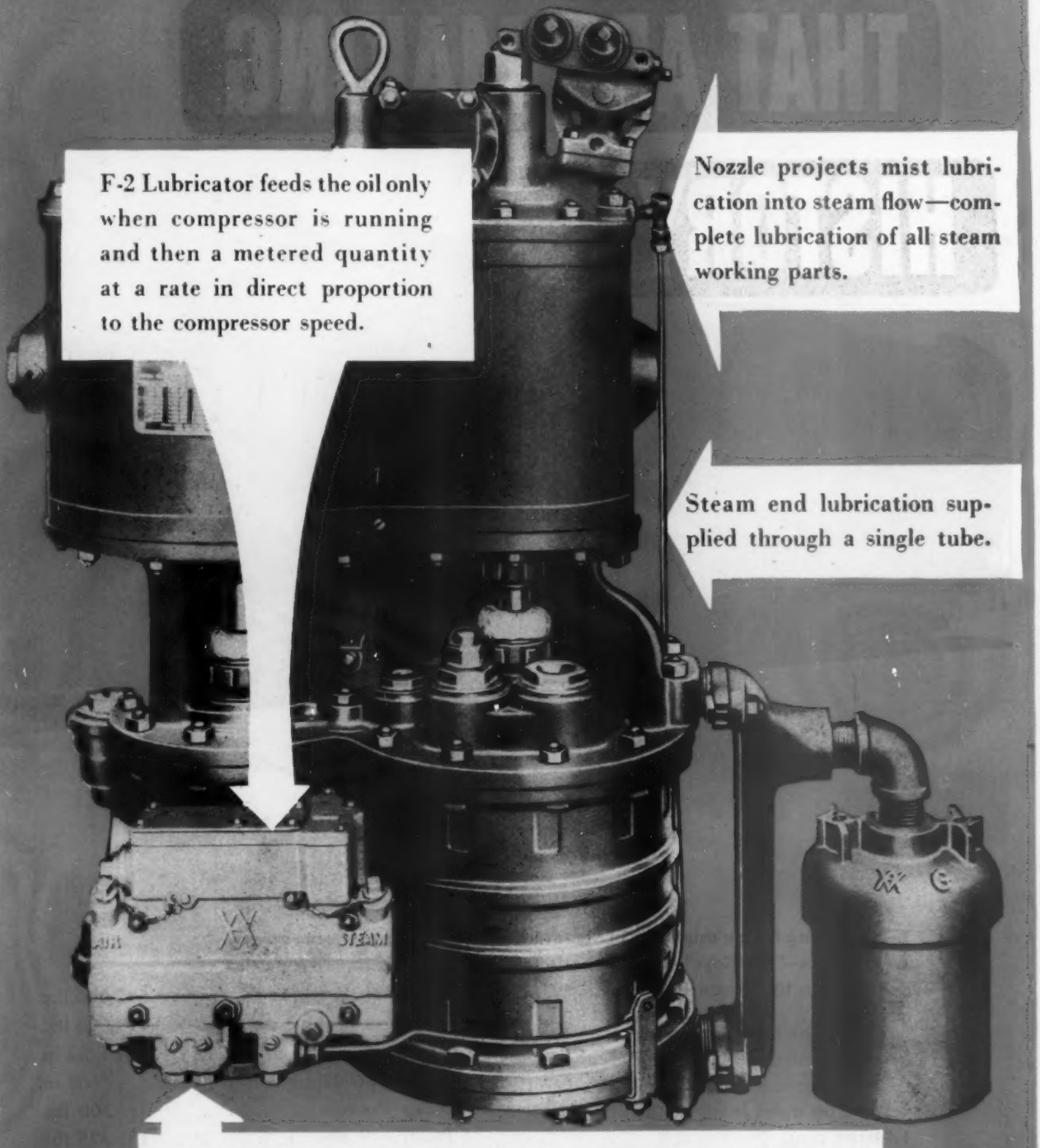
Controlled Compressor Lubrication *by* "F-2" Lubricator


F-2 Lubricator feeds the oil only when compressor is running and then a metered quantity at a rate in direct proportion to the compressor speed.
Nozzle projects mist lubrication into steam flow—complete lubrication of all steam working parts.
Steam end lubrication supplied through a single tube.
AIR
STEAM

F-2 Lubricator Mounted on Pads on the Air Cylinders. Air cylinders lubricated through feed ports in mounting pads.

Westinghouse Air Brake Company

Wilmerding, Pa.

LOCOMOTIVES THAT ARE MAKING HISTORY

FIVE more of the mightiest of steam locomotives—"Big Boys"—have recently been delivered to the Union Pacific.

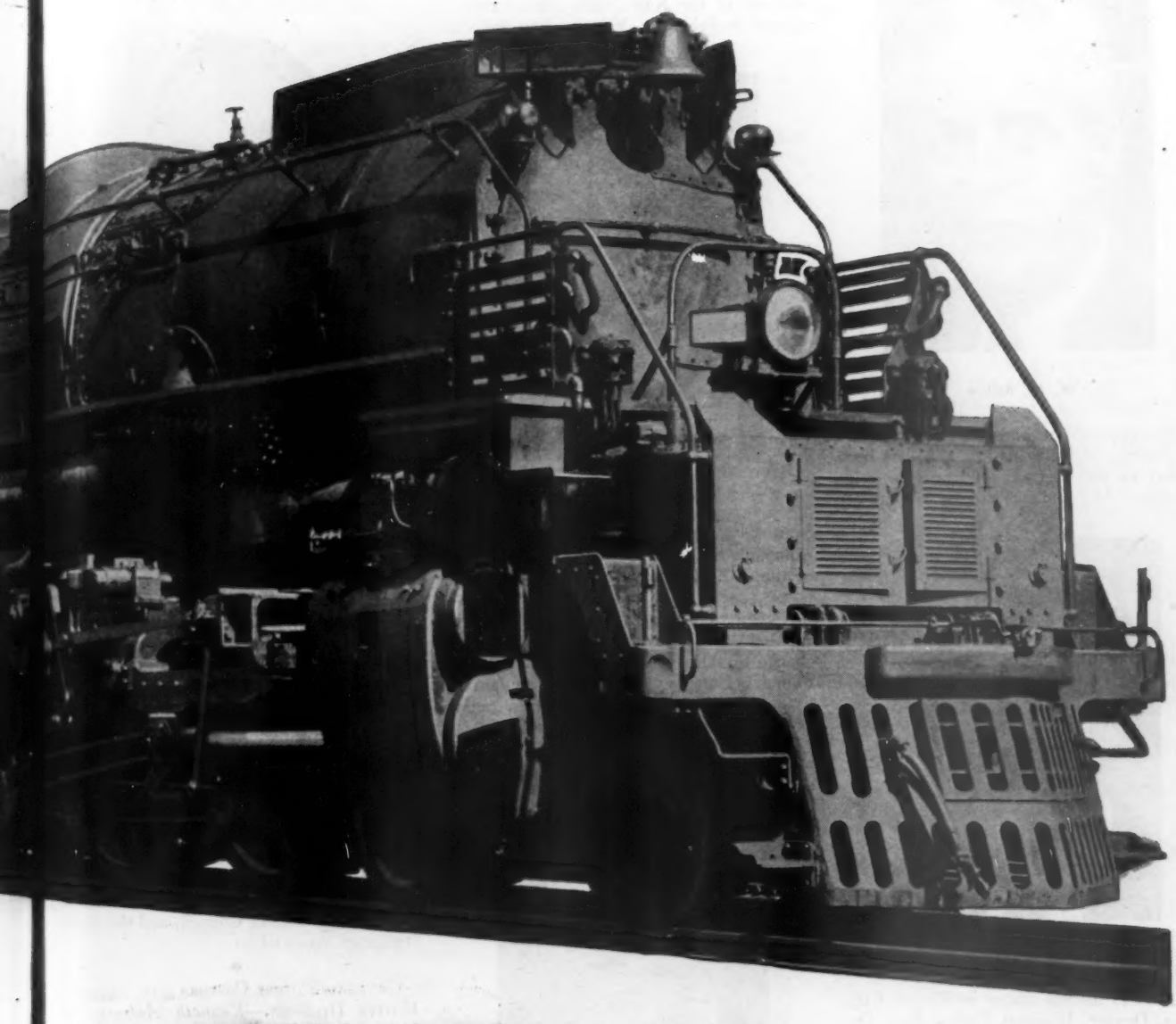
These powerful locomotives are hauling freight trains of 3,500 tons over the Ogden-Green River run daily, without a helper. One section, 66 miles long, has a ruling grade of 1.14 per cent.

American Locomotive has delivered 25 of these "Big Boys" to the Union Pacific. The first "Big Boy" was delivered in September 1941, just in time to take care of the heavy freight being shipped by rail through the Ogden-Green River district; 3,836,143,000 gross ton miles in 1941; 5,958,950,000 gross ton miles in 1943.

Here are the "SPECS":

Weight on Drivers	545,000 lbs.
Weight of Engine	772,000 lbs.
Cylinders	23¾ x 32 in.
Diameter of Drivers	68 in.
Boiler Pressure	300 lbs.
Tractive Power	135,375 lbs.
Tender Capacity—Water	25,000 gals.
Tender Capacity—Fuel	28 tons

Locomotive designs developed by American Locomotive Company have been, are, and will continue to be powerful factors in American railroad operating efficiency and economy.

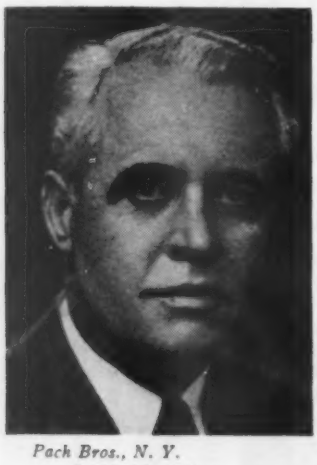


● *Unsurpassed for the Job because Built for the Job*

American Locomotive

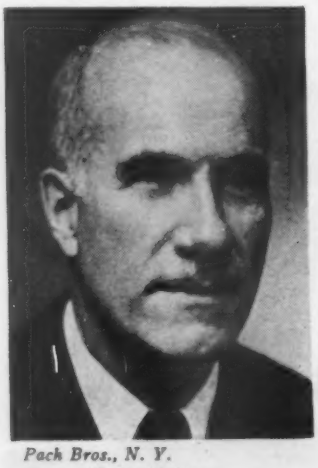
NEW YORK

H. S. McPherson, in charge of mechanical goods sales in St. Louis since 1935, has been appointed midwestern sales manager



Pach Bros., N. Y.
W. M. Ballew

of the mechanical goods division, and *W. M. Ballew*, of Kansas City, Mo., has been shifted to the post of southwestern sales manager. Mr. Ballew will be responsible



Pach Bros., N. Y.
H. S. McPherson

for sales in branch offices in Kansas City, Tulsa, Denver, Houston, Dallas, New Orleans, Omaha and Minneapolis. Mr. McPherson's territory includes Detroit, Cincinnati, Indianapolis, Chicago, Milwaukee and St. Louis.

◆

T-Z Railway Equipment Company.—*L. R. Gurley* has been appointed vice-president of the T-Z Railway Equipment Company, Chicago. Mr. Gurley will, in addition to engineering and production responsibilities, be in charge of railway sales in the eastern and northeastern states. Mr. Gurley was born in Altoona, Pa., and is a graduate in railway mechanical engineering of the University of Pittsburgh, Pa. (1920). In January, 1923, he completed a three-year course as a special apprentice in the Altoona shops of the Pennsylvania and became a motive-power inspector assigned to the office of the superintendent of motive power at Pittsburgh. In May, 1924, he became associate editor of the Railway Age and *Railway Mechanical Engineer*. He left the Simmons-Boardman Publishing Corporation in 1929 to become editor of Welding, a publication of Steel Publications, Inc. In 1935 he rejoined the Simmons-Boardman publications as a business department representative at Chicago and in 1940 was transferred to the eastern territory, working out of the New York office. He resigned in February, 1944, to join the Chi-

L. R. Gurley

cago sales staff of the Haire Publishing Company, and now becomes vice-president of the T-Z Railway Equipment Company.

◆

American Car and Foundry Company.—*R. A. Williams* has been appointed in charge of sales for the American Car and Foundry Company to succeed William L. Stancliffe, whose retirement from active

R. A. Williams

service was reported in the January issue. *George W. Mitsch* assistant manager of foundries at the Madison, Wis., and St. Louis, Mo., plants since 1935, has been appointed operating manager of all American Car and Foundry Company foundries.

R. A. Williams was elected a vice-president of the company in December, 1943, and had been Mr. Stancliffe's chief assistant in the sales organization. He joined the engineering department at the St. Louis, Mo., plant in 1924 and subsequently served in varying capacities as sales engineer at several of the company's sales offices and more recently as district sales manager at the Cleveland, Ohio, and Washington, D. C., offices.

George W. Mitsch joined the American Car and Foundry Company's St. Louis foundry in 1913 as a patternmaker apprentice. He subsequently was appointed draftsman at that plant, and, later, engineer of

George W. Mitsch

foundries. Mr. Mitsch served twice as president of the St. Louis Foundrymen's Club and affiliated this organization with the American Foundrymen's Association, with which he has continued his activity. He also has been connected with the Association of Manufacturers of Chilled Car Wheels, having assisted in the preparation of the first specification and operating standards, and the institution of the inspection service covering the production of chilled car wheels. He has been active in railway car wheel design and testing, both for the American Car and Foundry Company and the association, and in 1940 was appointed a member of the president's advisory committee to formulate plans for wheel improvements. On completion of this work he was appointed a member of the design committee. Mr. Mitsch is a member of the Car Department Association of St. Louis, the St. Louis Safety Council, and the Army Ordnance Association.

◆

General Motors Corporation, Electro-Motive Division.—*Kenneth Auburn* and *Milton LaRiviere* have been appointed to the sales staff of the eastern sales office

Kenneth Auburn

of the Electro-Motive Division, General Motors Corporation, with headquarters

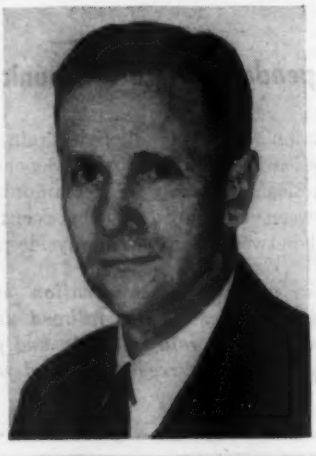
at New York. Mr. Auburn will assist *Paul R. Turner*, eastern regional manager, with northeastern regional sales, and Mr. LaRiviere will assist in the southeastern region. Mr. Auburn was formerly New

Milton LaRiviere

York district sales manager of the American Locomotive Company, with which company he had been employed for the past 20 years. Previously to his appointment as district sales manager he had served in the engineering and shop departments. He is a member of the New York Railroad Club, the New England Railroad Club, and the Central Railway Club of Buffalo. Mr. LaRiviere was previously with the Atlantic Coast Line for about 15 years following a period of employment in the Boston, Mass., office of the Canadian National. He received his education at the Boston University, the School of Business Administration, and at the Harvard University's Extension Institute on Transportation.

◆

EASTERN RAILWAY SUPPLIES, INC.—*George M. Cooper*, southwestern representative of the Southern Wheel and Brake Shoe & Castings divisions of the American Brake Shoe Company, has been appointed



George M. Cooper

sales manager of Eastern Railway Supplies, Inc., New York, to succeed *W. E. Bugbee*, who has resigned to become a manufacturers' representative for railway equipment and supplies in the Southwest, with headquarters at San Antonio, Tex. *James F. Hartley*, formerly in charge of the Cleveland, Ohio, territory for the Buda Company, has been appointed sales and service engineer of Eastern Railway Supplies, with headquarters at New York.

George M. Cooper received his education at the Drake Business school and Sales Analysis Institute, and then entered the employ of the Ramapo Iron Works, which later became the Ramapo Ajax Division of the American Brake Shoe Company, serving with this company in various capacities for 26 years. During most of this period he served as eastern representative, with headquarters at New York, but in July, 1942, he was transferred to Houston, Tex., as southwestern representative of the Southern Wheel and Brake Shoe & Castings divisions of the American Brake Shoe Company. He resigned in September, 1944, to become sales manager of Eastern Railway Supplies, with headquarters at New York.

◆

AIRCRAFT ACCESSORIES CORPORATION; AIREON MANUFACTURING CORPORATION.—The Aircraft Accessories Corporation, Kansas City, Kan., has changed its name to the Aireon Manufacturing Corporation. The name "Aireon" is intended to convey the thought that the products being manufactured are partly in the mechanical field as applied to aircraft and partly in the use of electronics as applied to various fields

Samuel W. Fordyce III

including train communication on railroads.

Samuel W. Fordyce III, assistant to the president of the Kansas City Southern, has been appointed general manager of the railway equipment division of the Aireon Manufacturing Corporation. In his new position, Mr. Fordyce will direct the introduction of the radio communications equipment for railroads as developed by Aireon and later market additional electronic and hydraulic equipment for use by railroads which the company expects to manufacture. Mr. Fordyce is a graduate of Harvard University and the Harvard Engineering School. He began his business career as an engineer for the Arkansas Power & Light Co., later becoming assistant general manager of the Mississippi Power & Light Co. He subsequently was employed for a number of years in banking and insurance in St. Louis, Mo., and began his railroad career in 1936 as industrial commissioner of the Louisiana & Arkansas. Shortly after the acquisition of this railroad by the Kansas City Southern Lines in 1938, he was appointed assistant to the executive vice-president and, in 1941, assistant to the president. During 1942, on a year's leave from the Kansas City Southern, he also served as assistant director in the Office of Defense Transportation in Washington.

◆

EUTECTIC WELDING ALLOYS COMPANY.—*C. F. Patterson and John A. Owen* have joined the field engineering staff of the Eutectic Welding Alloys Company, New York. Mr. Patterson will serve Eutectic customers in Michigan; Mr. Owen, in the state of North Carolina.

Obituary

JAMES D. CARTIN, general manager of the New York Air Brake Company's plant at Watertown, N. Y., died December 16.

◆

CHARLES S. TROTT, assistant treasurer and sales manager of the Parker-Kalon Corporation, died December 19. Mr. Trott was 45 years of age.

◆

FRANK B. ARCHIBALD, vice-president of the National Lock Washer Company at Newark, N. J., died at a hospital in New Rochelle on December 19.

◆

CHARLES E. BROWN, executive vice-president of The Okonite Company and vice-president of the Okonite-Callender Cable Company, Inc., died in Chicago on January 13. Mr. Brown was born in Philadelphia, Pa., on July 15, 1866, and at the age of 18 entered the employ of Marshall Field & Co., Chicago. Five years later he resigned to become vice-president of the Central Electric Company, Chicago. In 1925 he

Charles E. Brown

was elected executive vice-president and a director of The Okonite Company, of which he had been a director from 1919 to 1925. In 1925 he was also elected vice-president and a director of the Okonite-Callender Cable Company, Inc.

◆

WILLIAM L. BLISS, inventor of axle systems of railroad passenger-car lighting, died December 5. Mr. Bliss was 73 years of age. He was a graduate, with a degree in mechanical engineering, of Cornell University

(*Continued on second left-hand page*)

Let's get down to earth
on train communication
ITC
Dependable voice communication
"Union" I.T.C. (Inductive Train Communication) system provides dependable, practicable two-way voice communication between vehicles of a train, between trains, and between trains and wayside points.
It is a train communication system designed exclusively for railroad use, by men who know railroad needs, and proved through years of regular railroad service.

Day or night, rain or shine, cuts or open country, ***dependable reception*** with "Union" I.T.C.

The Frequency Modulated carrier currents used in the "Union" I.T.C. system are transmitted along the track and along line wires paralleling the track. Vehicles receive the modulated wave inductively.

"Union" I.T.C. is dependable everywhere, under all weather and operating conditions and in all types of country.

Transmission and reception are not spoiled by snow, rain, electrical storms, sun spots or other meteorological conditions. Neither are they impaired by bridges, buildings or other structures. You get the same dependable results in a deep cut between ore-bearing hills as in open country.

Dependability, always, everywhere —that's another reason why, for train communication, *"Union" I.T.C. is the answer.*

Full information will be furnished without obligation by our nearest district office.

UNION SWITCH & SIGNAL COMPANY

SWISSVALE PENNSYLVANIA

NEW YORK CHICAGO ST. LOUIS SAN FRANCISCO

in 1893. He was an electrician for the Riker Electric Motor Company of Brooklyn, N. Y., and an electrical engineer for the Consolidated Gas Company of New York before founding his own company, the Bliss Electrical Car Lighting Company in 1900. When the company was merged with several others to form the United States Lighting & Heating Co., Mr. Bliss was appointed chief engineer of the new firm and of the U. S. L. Battery Corporation. He retired in 1941 but continued to act as consulting engineer to the last-named firm.

A. P. STEINER, formerly chief engineer and superintendent of the Landis Tool Company, Waynesboro, Pa., died on January 8. Mr. Steiner had been with the Landis Tool Company since 1899 and during the past few years had acted in the capacity of consulting engineer.

Personal Mention

General

R. J. SNYDER, general foreman, car department of the Wheeling & Lake Erie at Brewster, Ohio, has been appointed assistant superintendent, motive power and cars, with headquarters at Brewster.

S. O. RENTSCHLER, mechanical superintendent of the Missouri Pacific, has been appointed assistant chief mechanical officer, with headquarters as before at St. Louis, Mo.

JOHN WESLEY HAWTHORNE, assistant superintendent of motive power of the Central of Georgia with headquarters at Savannah, Ga., has been appointed superintendent of motive power as noted in the January issue. Mr. Hawthorne was born on March 29, 1911, at Williamsport, Pa., and is a graduate of Purdue University (1933) with a B.S.M.E. degree. He then

John Wesley Hawthorne

worked at the Watertown, N. Y., plant of the New York Air Brake Company from July, 1933, until July, 1936, when he was transferred to Cleveland, Ohio, as a service representative. In 1940 he was granted a six months' leave from January through June to become acting air-brake instructor of the Chesapeake & Ohio at Richmond, Va., returning to the New York Air Brake Company at Cleveland as service representative. Mr. Hawthorne entered the service of the Central of Georgia on November 1, 1943, as assistant superintendent of motive power at Savannah.

J. O. HILL, assistant superintendent, motive power and cars of the Wheeling & Lake Erie at Brewster, Ohio, has been appointed superintendent, motive power and cars with headquarters at Brewster.

W. C. MARSHALL, assistant superintendent of motive power of the Chicago, Milwaukee, St. Paul & Pacific at Milwaukee, Wis., has been appointed assistant superintendent of motive power in charge of Diesel operation, with headquarters at Milwaukee.

G. E. DURHAM, superintendent, motive power and cars of the Wheeling & Lake Erie at Brewster, Ohio, has been appointed assistant vice-president, reporting to the executive vice-president and general manager, with headquarters at Cleveland, Ohio.

J. L. BROSSARD, division master mechanic, of the Chicago, Milwaukee, St. Paul & Pacific, at Chicago, has been appointed assistant superintendent of motive power, with headquarters at Milwaukee, Wis.

C. L. DICKERT, superintendent of motive power of the Central of Georgia at Savannah, Ga., has retired as noted in the January issue. Mr. Dickert was born in Newberry County, S. C., on October 12, 1873, and entered railroad service in 1890 as a machinist apprentice of the Richmond & Danville at Atlanta, Ga. After the Richmond & Danville merged with the Southern in 1896 he was transferred to the Southern shops in Atlanta as a machinist, later serving with the Atlanta, Knoxville & Northern (now part of the Louisville & Nashville) at Blue Ridge, Ga., from 1898 to 1899. He then became a locomotive fireman on the Central of Georgia. Some months later he returned to mechanical

C. L. Dickert

service as a machinist in the Columbus shops, and after working in the Savannah and Macon (Ga.) shops, became erecting-shop foreman, machine shop foreman, shop superintendent and master mechanic at Macon. On July 16, 1923, he was appointed superintendent of motive power.

E. G. JONES, general foreman of the Atlantic Coast Line at Tampa, Fla., has been appointed superintendent of motive power of the Charleston & Western Carolina, with headquarters at Augusta, Ga.

M. W. MCMAHON has been appointed locomotive appliances inspector of the New York Central System with headquarters at New York.

PAUL VICTOR GARIN, who has been appointed engineer of tests of the Southern Pacific at San Francisco, Calif., as noted in the December issue, was born on February 28, 1914, at San Francisco. He is a graduate of the University of California,

P. V. Garin

College of Engineering (1935). He entered the employ of the Southern Pacific on December 1, 1935, as a junior draftsman. He became dynamometer car assistant in March, 1936; draftsman, in May, 1936; inspector, new equipment, in November, 1941; lubrication engineer, in September, 1942; assistant engineer of tests in April, 1943, and engineer of tests in August, 1944.

A. G. HOPPE, assistant to the mechanical assistant, chief operating officer, of the Chicago, Milwaukee, St. Paul & Pacific, has been named assistant chief mechanical officer, with headquarters as before at Milwaukee, Wis. This is a change of title.

E. W. PEWESTORFF, road foreman of engines of the Chicago & North Western at Chicago, has been appointed supervisor of motor-car equipment with headquarters at Chicago.

H. L. FERGUSON, road foreman of engines of the Union Pacific, has been appointed general mechanical inspector, with headquarters at Cheyenne, Wyo.

(Turn to next left-hand page)

ARE YOUR LOCOMOTIVES HAULING
A WHITE ELEPHANT
Why make your locomotives haul "a white elephant"—a passenger cooling system that piles on an extra and unnecessary load? Steam, axle or electrically driven systems are power parasites. Ice activated systems are weighty, wasteful and expensive.
The Waukesha Railway Ice Engine imposes no power drag or additional load upon the locomotive. Independently powered, propane fueled . . . it insures continuous, uniform, modulated cooling . . . anytime, anywhere regardless of train movement or car location. No power line! No steam connections! No ice!
Send for complete details on the Waukesha Ice Engine for initial or conversion installation.
REFRIGERATION DIVISION
WAUKESHA MOTOR COMPANY, WAUKESHA, WISCONSIN

10 Years Operation

have TESTED and PROVED IT!

WAUKESHA

ENGINE-DRIVEN *Equipment*

In 1935, one railroad started operating one coach with Waukesha engine-driven equipment . . .

And *Railway Age* in its Sept. 14, 1935 issue carried an article about it, headed "Air Conditioning with No Locomotive Power Drag" . . .

Or, as one of the early Waukesha advertisements so aptly puts it—"Why make your locomotives haul a white elephant? . . . an extra and unnecessary load. Steam, axle or electrically driven systems are power parasites."

Right! Then . . . *and now!* In ten years . . . and more than 25,000,000 miles of operation on famous-name trains and twenty-five major American railways including the Pullman Company . . . Waukesha Engine-Driven Air Conditioning and Generator Units have been tested *and proved* beyond question!

There's no parasite load—all the locomotive's horsepower, formerly diverted to air-conditioning and electric services, is available to pull the train. Waukesha engine-driven units completely take over—supply modern deluxe air conditioning and lighting *on demand*—independent of train movement, weather conditions or car location.

Find out how Waukesha can give your trains added pay-load, faster schedules, lower operating costs. Details sent without obligation.

REFRIGERATION DIVISION

WAUKESHA MOTOR COMPANY • WAUKESHA, WIS.

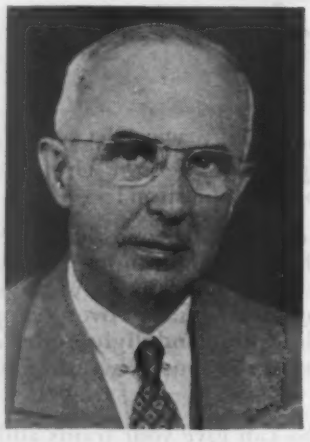
LARGEST BUILDERS OF MOBILE ENGINE-DRIVEN REFRIGERATION AND GENERATOR EQUIPMENT

WILLIAM H. C. CHAPMAN, assistant electrical engineer of the Chicago & North Western at Chicago, has been appointed electrical engineer, with headquarters at

William H. C. Chapman

Chicago. Mr. Chapman was born at Leyland, England, on August 26, 1886. He received his higher education at the Salford Royal Technical School, Salford, England, and held a number of positions in England after graduation. In 1910 he came to the United States and accepted a position with the Commonwealth Edison Company, Chicago, and later was in the employ of the Chicago Bell Telephone Company. Mr. Chapman in 1911 became an electrician in the service of the North Western at Chicago, and three years later was appointed chief electrician with headquarters at Clinton, Iowa. In 1916 he became electrical inspector, with headquarters at Chicago, and in 1927, assistant electrical engineer.

J. A. ANDREUCETTI, electrical engineer of the Chicago & North Western, at Chicago, has been appointed chief electrical engineer, with headquarters at Chicago. Mr. Andreucetti was born at Chicago on May 1, 1881, and entered railway service in 1901



J. A. Andreucetti

in the operating department of the Illinois Central. In 1905 he went with the North Western as an electrical helper at Chicago, subsequently serving as electrician, acting foreman on electrical construction, foreman on electrical construction and general foreman. In September, 1916, Mr. Andreucetti was appointed assistant electrical engineer, and in May, 1927, electrical engineer. Mr. Andreucetti is a past president of the Railway Electrical Engineers, and present retary-treasurer of the Association of Railway Electrical Engineers, and a former secretary of the Electrical section, Mechanical division, A. A. R.

M. P. HANNON has been appointed mechanical inspector of the Chicago, Milwaukee, St. Paul & Pacific at Milwaukee, Wis.

Master Mechanics and Road Foremen

S. H. KAHLER, master mechanic of the Toledo Terminal at Toledo, Ohio, has resigned.

L. L. ROBINSON, JR., has been appointed master mechanic of the Baltimore & Ohio, with headquarters at Glenwood, Pa.

O. J. ROBINSON, district foreman of the Nebraska division of the Union Pacific at Council Bluffs, Iowa, has been appointed assistant master mechanic, with headquarters at Council Bluffs.

R. C. HEMPSTEAD, assistant superintendent of motive power of the Chicago, Milwaukee, St. Paul & Pacific at Milwaukee, Wis., is being relieved of that position at his own request and has been appointed division master mechanic, with headquarters at La Crosse, Wis.

H. C. DUGAN has been appointed master mechanic of the Toledo Terminal at Toledo, Ohio. Mr. Dugan was formerly general foreman of the New York, Chicago & St. Louis at Conneaut, Ohio.

H. L. CRANE, assistant master mechanic of the Union Pacific at Pocatello, Idaho, has been appointed master mechanic, with headquarters at Spokane, Wash.

RALPH LOGEMAN, general enginehouse foreman of the Chicago Great Western at Oelwein, Iowa, has been promoted to master mechanic, with the same headquarters.

P. C. BRANCH, general foreman of the Southern at Birmingham, Ala., has been appointed master mechanic, with headquarters at Ludlow, Ky.

Car Department

W. C. HUNT has been appointed assistant supervisor car repairs, Eastern district, of the Erie, with headquarters at Cleveland, Ohio.

F. J. LARRISSEY, chief A. A. R. inspector of the Erie at Cleveland, Ohio, has been appointed chief shop inspector, with headquarters at Cleveland.

A. V. NYSTROM, general car foreman of the Chicago, Milwaukee, St. Paul & Pacific at Kansas City, Mo., has been appointed assistant to the superintendent of the car department, with headquarters at Milwaukee, Wis.

Purchasing and Stores

WALTER S. GALLOWAY, purchasing agent of the Baltimore & Ohio at Baltimore, Md., has retired. Mr. Galloway entered railway service in June, 1889, as a machinist apprentice in the employ of the Cincinnati, Hamilton & Dayton (now the Baltimore & Ohio). After serving successively as claim clerk, locomotive fireman and rodman in the engineering corps of that road, Mr. Galloway in February, 1900, became inspector of material of the B. & O. He became resident inspector at Pittsburgh, Pa., thereafter, and served subsequently as assistant engineer of tests at Baltimore, enginehouse foreman and general foreman at Cumberland, assistant master mechanic at Mt. Clare (Baltimore), and master mechanic at Grafton, W. Va. He was appointed assistant to the purchasing agent at Baltimore in March, 1905; purchasing agent for the Allegheny region in 1918, and purchasing agent for the system in March, 1920.

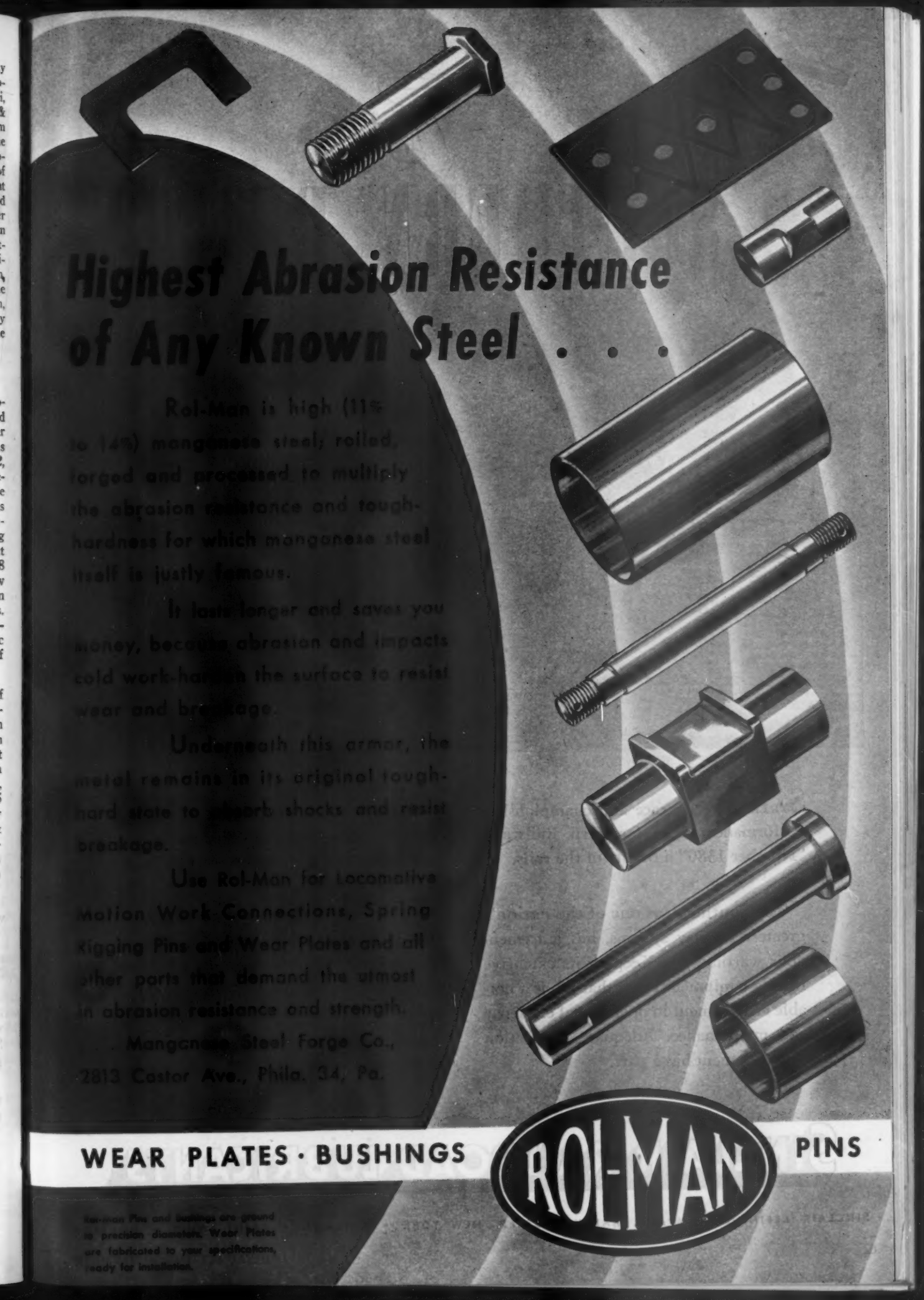
Obituary

HUGH RONALDS, superintendent of motive power of the Lehigh & New England at Pen Argyl, Pa., died there on December 20. Mr. Ronalds was 56 years old. He was born at Brooklyn, N. Y., on February 22, 1888. In 1906 he became a locomotive fireman on the Long Island. He entered the employ of the Lehigh & New England as a fireman on November 18, 1913, and became a locomotive engineer the following May. After serving with the merchant marine as a marine engineer from 1918 to 1922, he returned to the Lehigh & New England as a locomotive engineer, and in March, 1923, became foreman of engines. He was appointed assistant master mechanic on January 1, 1929; master mechanic on February 1, 1930, and superintendent of motive power on May 20, 1931.

T. M. KIRKBY, chief mechanical officer of the Green Bay & Western, with headquarters at Green Bay, Wis., died while on a hunting trip near Crandon, Wis., on November 26. Mr. Kirkby was born at Oslo, Norway, on July 4, 1886, and was a graduate of the University of Norway, Oslo. He entered railway service in 1905 as a mechanical draftsman in the employ of the Chicago, Milwaukee, St. Paul & Pacific, subsequently serving as a mechanical draftsman on the Duluth & Iron Range (now the Duluth, Missabe & Iron Range), from 1911 to 1916. In the latter year he returned to the Milwaukee as a mechanical draftsman; two years later became chief draftsman, mechanical department, at Chicago, and in 1922 mechanical assistant to the general superintendent. In 1926 Mr. Kirkby went with the Missouri-Kansas-Texas as mechanical engineer with headquarters at Parsons, Kan. On April 1, 1936, he became mechanical representative of the G. B. & W.; five months later, superintendent of motive power and equipment at Green Bay, and one February 1, 1944, chief mechanical officer.

JOHN FLETCHER, general inspector of the Seaboard Air Line at Norfolk, Va., died there on November 22. Mr. Fletcher was 59 years old.

A. P. PRENDERGAST, who retired as mechanical superintendent of the Texas & Pacific at Dallas, Tex., in 1934, died on October 17 at Cameron, W. Va.


Highest Abrasion Resistance of Any Known Steel . . .
Rol-Man is high (11% to 14%) manganese steel; rolled, forged and processed to multiply the abrasion resistance and tough-hardness for which manganese steel itself is justly famous.
It lasts longer and saves you money, because abrasion and impacts cold work-harden the surface to resist wear and breakage.
Underneath this armor, the metal remains in its original tough-hard state to absorb shocks and resist breakage.
Use Rol-Man for Locomotive Motion Work Connections, Spring Rigging Pins and Wear Plates and all other parts that demand the utmost in abrasion resistance and strength.
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WEAR PLATES · BUSHINGS
ROL-MAN
PINS
Rol-man Pins and Bushings are ground to precision diameters. Wear Plates are fabricated to your specifications, ready for installation.

To a

"SOUTHERN" BEAUTY

STREAMLINED grace and championship performance make Southern Railway's "Number 1380" a beauty of the rails.

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The Southern, as one of the nation's greatest railway systems, has a tremendous wartime job. Keeping its extensive rolling equipment up to that job is a notable achievement in operational efficiency and maintenance. Adequate lubrication for equipment has a part.

Southern uses many Sinclair lubricants over its system, including Sinclair Superheat Valve Oil for "Number 1380" and other steam locomotives.

Superheat Valve Oil is designed for complete lubricating efficiency under extreme heat and pressure. It has superior adhesive qualities, high viscosity, high film strength, and great resistance to carbonization.

It is but one of the Sinclair lubricants used on more than 150 American railroads.

SINCLAIR RAILROAD LUBRICANTS

SINCLAIR REFINING COMPANY, *RAILWAY SALES*, NEW YORK • CHICAGO • SAINT LOUIS • HOUSTON

The ROLLER BEARING Did it!

What has given railroad passengers the smoothest ride in railroading history? . . The Roller Bearing

What has helped American railroads to increase train speeds? . . . . . The Roller Bearing

What has eliminated hot boxes and attendant delays? . . . . . The Roller Bearing

What has made it possible to so greatly extend non-stop runs? . . . . . The Roller Bearing

What has helped to make possible the remarkable development of American high-speed streamlined trains? . . . . . The Roller Bearing

What has made possible the greatly increased availability and utilization of all types of locomotives and cars? . . . The Roller Bearing

What has extended lubrication periods from days to months? . . . . The Roller Bearing

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The great majority of American high-speed streamlined trains use TIMKEN ROLLER BEARINGS, as do most new locomotives. TIMKEN BEARINGS will do the same outstanding job on freight cars as they now are doing on all types of locomotives and passenger cars.

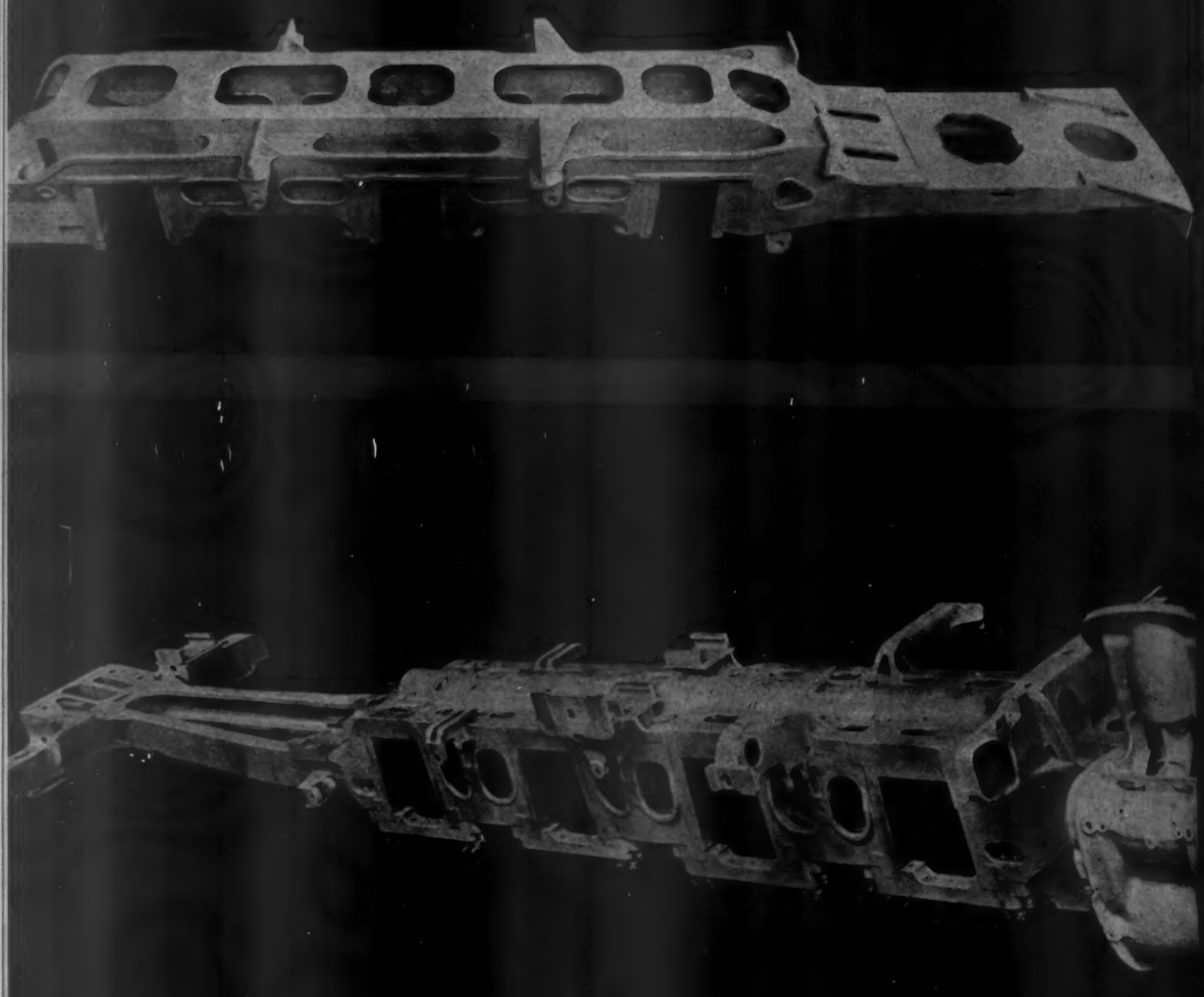
THE TIMKEN ROLLER BEARING COMPANY, CANTON 6, OHIO

TIMKEN

RAILWAY ROLLER BEARINGS

TWENTY YEARS

Have Produced



GENERAL STEEL

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the COMMONWEALTH LOCOMOTIVE BED of Today

1924

Original Locomotive Bed. Weight 18,000 lbs. Length 30' 10½".

1944

Commonwealth Locomotive Bed of latest design with Cradle, Cylinders, and Air Reservoirs Cast Integral; Weight 70,000 lbs. Length 34' 0".

Since 1924, great strides have been made, not only in design, but in the technique of manufacture, including the art of moulding these intricate castings, in producing better steel, and in machining to closer tolerances. The result is the COMMONWEALTH CAST STEEL LOCOMOTIVE BED of today that gives you *all* of these advantages, and more:

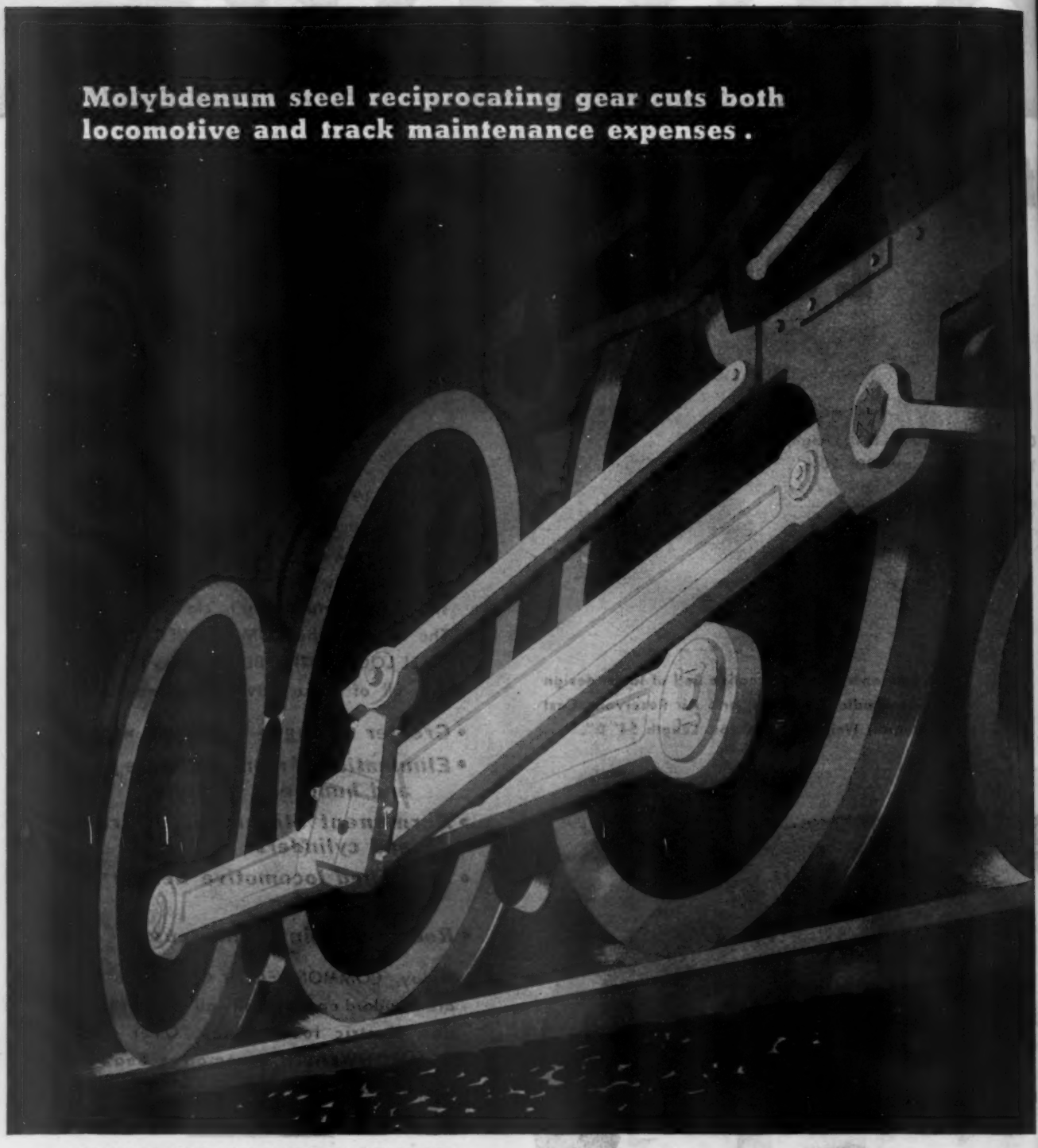
- ***Greater strength with less weight***
- ***Elimination of many separate parts and hundreds of bolts***
- ***Permanent alignment of frame and cylinders***
- ***Simplified locomotive design and construction***
- ***Reduced maintenance costs.***

Today, *COMMONWEALTH ONE-PIECE BEDS* are standard on practically all modern steam and electric locomotives. Over 4,900 COMMONWEALTH Locomotive Beds are now in service on or on order for the railroads of the world.

LOCOMOTIVES EQUIPPED WITH COMMONWEALTH BEDS SPEND MORE TIME ON THE ROAD—LESS TIME IN REPAIR SHOPS.

CASTINGS EDDYSTONE, PA. GRANITE CITY, ILL.

Molybdenum steel reciprocating gear cuts both locomotive and track maintenance expenses.



CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.

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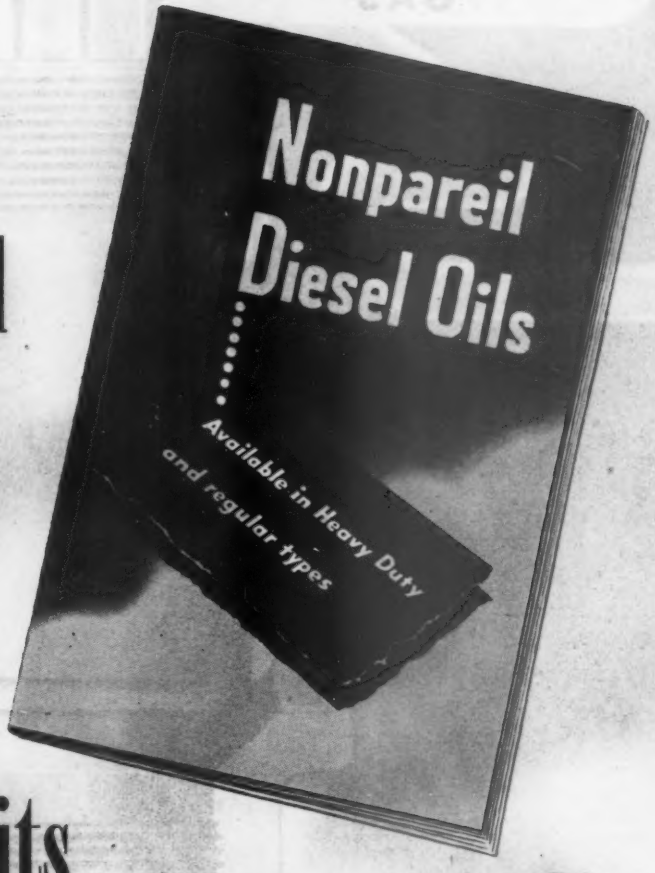
Eliminate stubborn and troublesome varnish and sludge deposits with . . .



For Industrial Diesels

For Railroad Diesels

NONPAREIL
DIESEL OILS

Gasoline Powers the Attack . . . Don't Waste a Drop!

Send for this booklet!

It tells why the heavy-duty, detergent grades of oil were added to the Nonpareil line of Diesel Oils, and how they insure engine cleanliness even under the adverse operating conditions of today.

It contains useful information such as: hints on filtering of heavy-duty oil, and tables on cooling water recommendations of various Diesel manufacturers. Write the nearest local Standard Oil Company (Indiana) office, or 910 South Michigan Avenue, Chicago 80, Illinois, for this brief factual booklet on Diesel lubrication.

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

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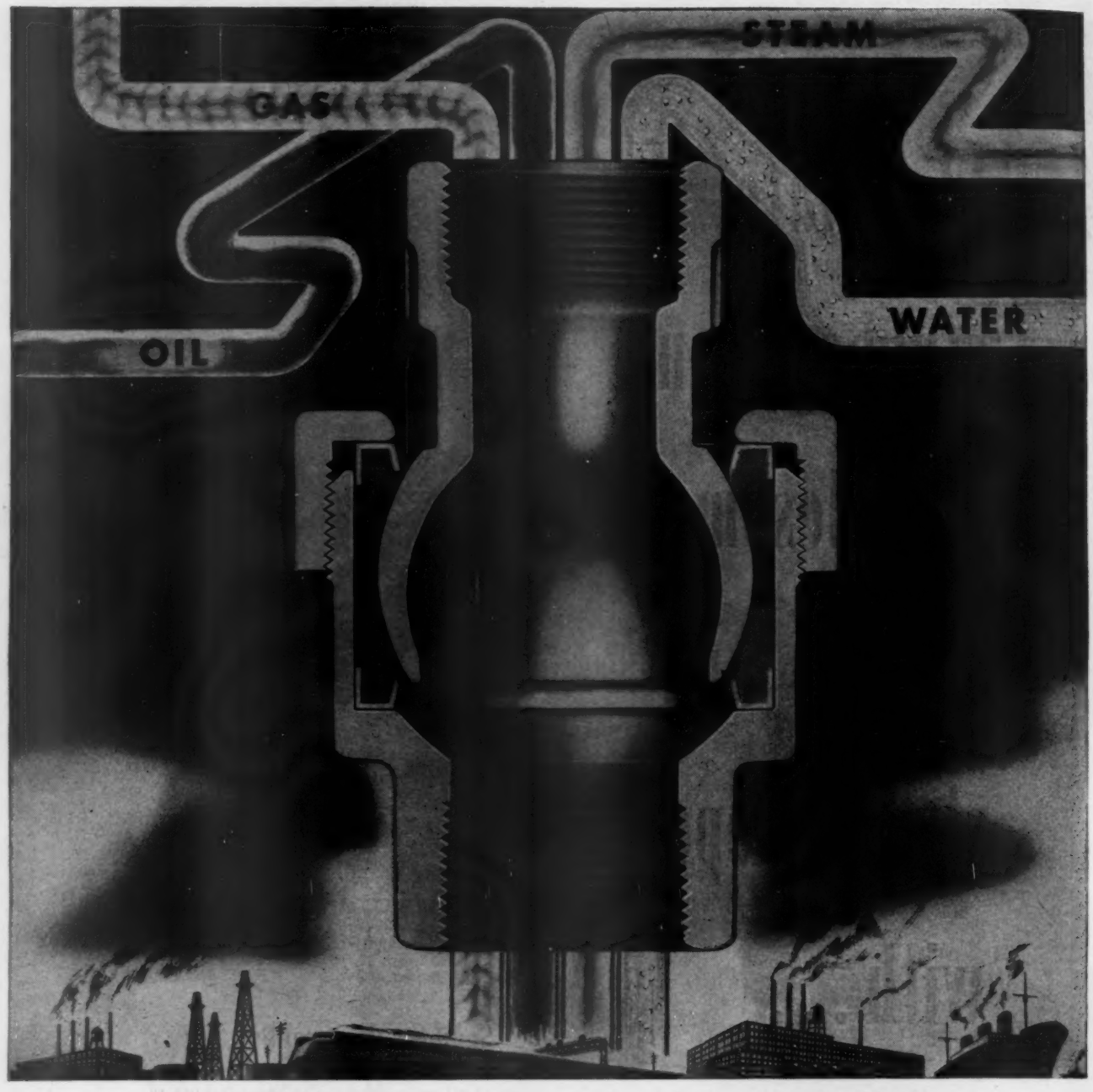

BARCO KEEPS VITAL FLUIDS FLOWING

The destructive action of vibration and shock can't hurt fluid-conveying pipes protected by Barco Flexible Joints. By means of responsive movement, Barco compensates for every contraction and expansion—preventing leaks and breaks. Its range of designs covers every flexible joint problem in transportation and industry. Today, as in the past 30 years, Barco's experience and progressive skill stand ready to assist you. Barco Manufacturing Co., Not Inc., 1808 Winnemac Avenue, Chicago 40, Illinois.

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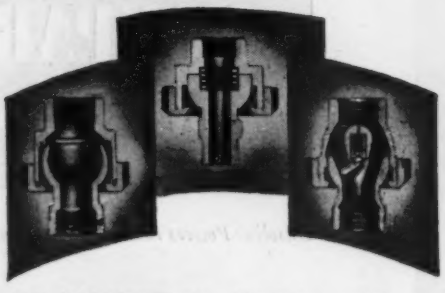
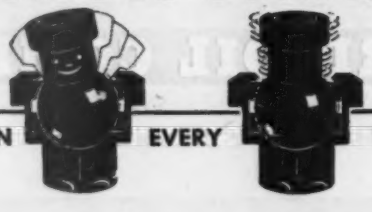


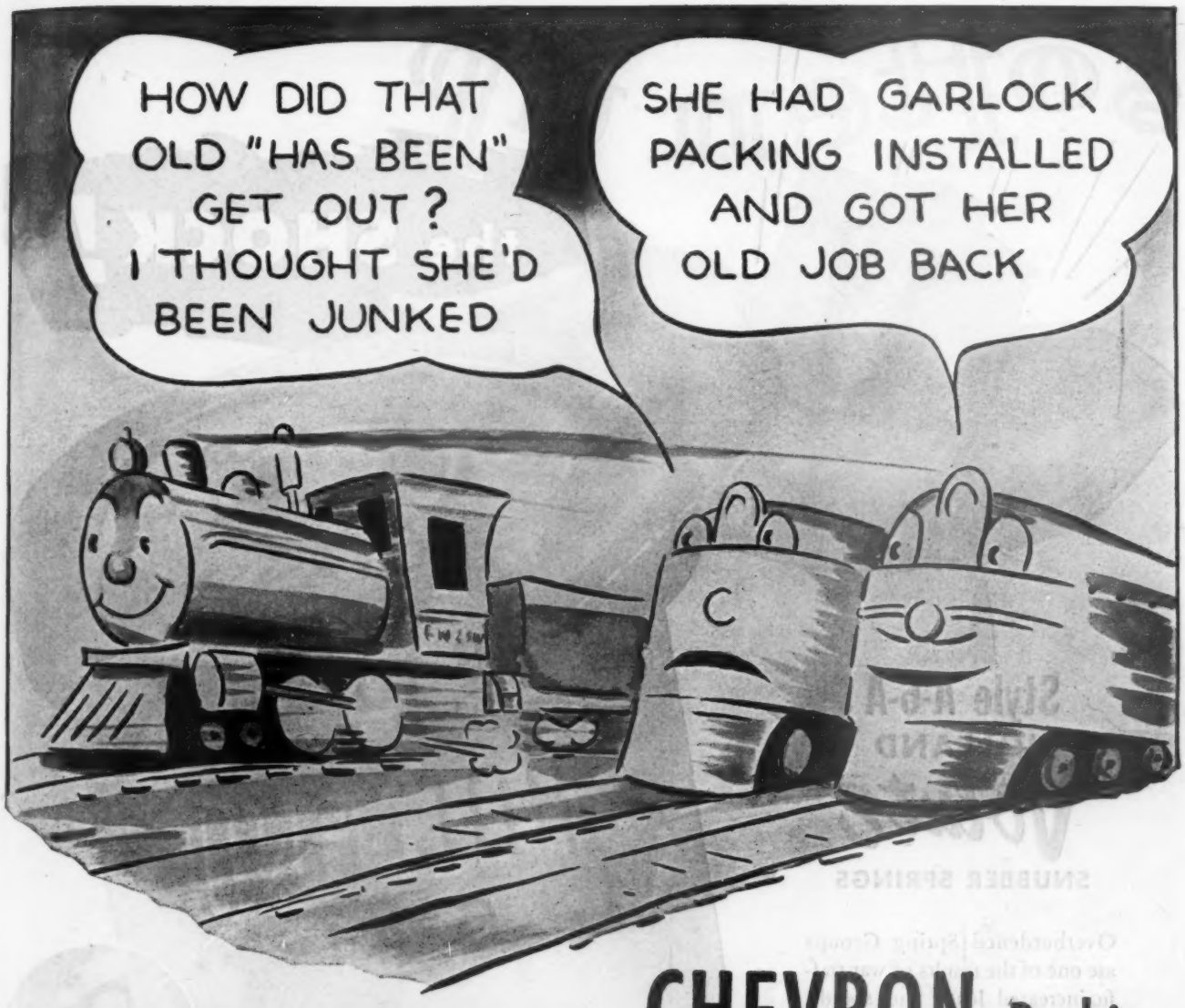
BARCO FLEXIBLE JOINTS

THE FREE ENTERPRISE SYSTEM IS THE SALVATION OF AMERICAN BUSINESS



Not just a swivel joint...but a combination of a swivel and ball joints with rotary motion and responsive movement through every angle.

"MOVE IN EVERY DIRECTION"



CHEVRON Packing

Yes, Garlock CHEVRON automatic action packing has proved itself on thousands of locomotive throttles and other locomotive applications. The unique hinge-like, cross-sectional design allows the packing to expand and contract—*the greater the pressure, the tighter it packs.* You can always depend on CHEVRON for superior performance.

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK
In Canada: The Garlock Packing Company of Canada Limited, Montreal, Que.

Garlock

soften up the SHOCK!

Style A-6-A HOLLAND Volute SNUBBER SPRINGS

Overburdened Spring Groups are one of the results of war-traffic-increased loads and speeds. The many-time-multiplied spring shocks are being softened on many cars by the use of Holland Volute Snubber Springs.

SIGNAL CORPS PHOTO

HOLLAND COMPANY

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BULLETINS giving complete data on Leslie Pressure Reducing Valves and Leslie-Tyfon Whistles for railroad service will be mailed upon request.

THEIR DEPENDABILITY, for fifteen years a byword in railroading, first led to the choice of Leslie-Tyfon Whistles and Signals for the streamliners. Their audibility range far exceeds that required by the fastest engines. Their clear notes form an unmistakable warning that alarms without antagonizing. They have the high operating efficiency that is synonymous with all Leslie products.

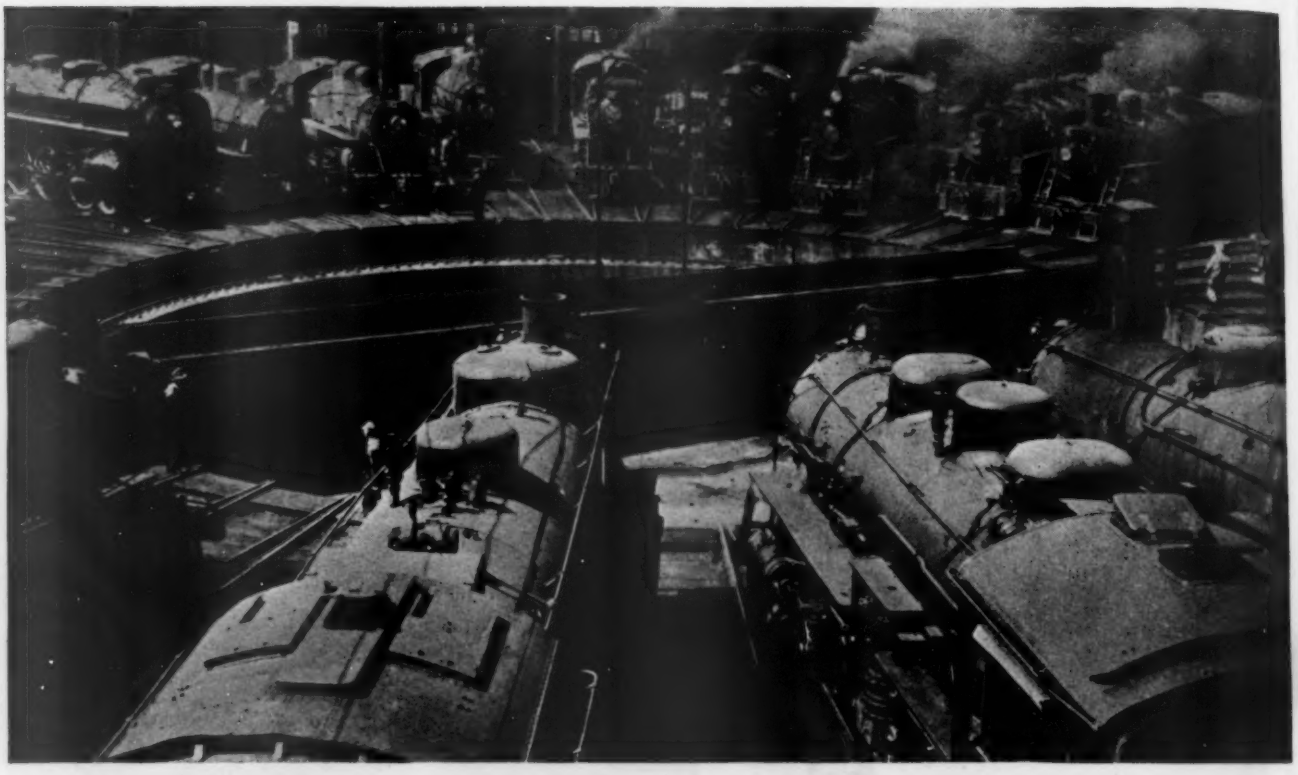
FOR MORE THAN FORTY YEARS, Leslie Pressure Reducing Valves have furnished stable low pressure steam for train heating systems, promoting passenger comfort and improving steam economy. Of the spring loaded, internal pilot, piston operated type, they are characterized by the highest quality materials, embodying a combination of refinements found in no other regulating valve.

LESLIE CO. LYNDHURST • NEW JERSEY

ESTABLISHED 1900

LESLIE

REGULATING VALVES
LESLIE-TYFON WHISTLES



HOW MANY HAVE WAR ULCERS?

KEEP YOUR LOCOMOTIVES "IN THE PINK" WITH APEXIOR SURFACING MATERIALS

You can overcome the tedious cleanings of boiler flues, shells and firebox sheets by coating them with APEXIOR NUMBER 1. An APEXIORIZED surface stays clean longer . . . wears longer . . . and washes more effectively. Dirt and scale do not bond as tightly to an APEXIORIZED surface.

APEXIOR NUMBER 1 is a brush-applied corrosion-proof surfacing material that seeps into the metal pores and joints to form an impenetrable barrier against water. The thickness of APEXIOR NUMBER 1 applied is approximately .0025". It does not retard heat transmission.

APEXIOR NUMBER 1 is not a substitute for feed-water preparation or chemical treatment. It supplies protection for metal in service under boiler water and steam temperatures and pressures, supplementing the work of the chemist and water service engineer by increasing the durability and raising the surface quality of the boiler metal. Here is the simplest and most effective kind of mechanical cooperation with the Water Service Department.

APEXIOR . . . TIME TESTED

Service experience of five years on steam locomotive boiler interiors is now available. These records demonstrate conclusively that APEXIOR effectively retards or checks corrosion and pitting in locomotive boilers, and cleaning time is reduced when flues are removed.

APEXIOR surfacing is recommended for stay bolts and other water contact areas subjected to the hazard of embrittlement or accelerated stress corrosion.

For protecting the interior of cisterns of locomotive tenders APEXIOR NUMBER 3 is recommended. This is brush-applied cold and dries to a smooth, shiny jet black. It resists all chemicals used in treating boiler water, also protects surfaces in contact with potable water.

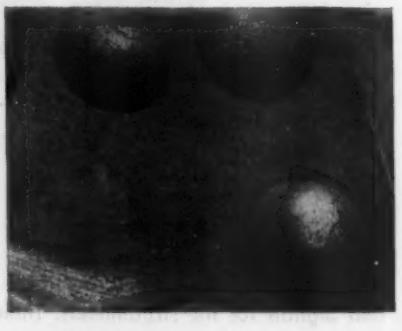
NO SCARCITY OF THIS ARMOR PLATE

Both APEXIOR surfacing materials are available. They are being shipped to hundreds of industrial power plants, utilities and for marine construction and operation as well as to railroads.

More and more railroads are coating new and old surfaces alike with APEXIOR to

1. Overcome manpower shortage
2. Save metal
3. Save time
4. Save money

Ask for bulletin.



APEXIOR surfaced boiler plate and rivet heads after two years of service under 215 pounds boiler operating pressure. Note brush marks and thickness of film over plate markings. Observe that no metal is exposed.

Keeps new metal new APEXIOR *Gives old metal new life*

THE DAMPNEY COMPANY OF AMERICA
HYDE PARK 36, BOSTON MASSACHUSETTS

ATLANTA CHICAGO NEW YORK DETROIT PHILADELPHIA

P-M Metallic Rod Packing is SIMPLE... SURE!

Simplicity is the design keynote of P-M Metallic Rod Packing. Its simplicity of design, based on sound engineering principles, is your assurance of outstanding operating performance. There is nothing complicated about the packing segment assembly. It is composed of a steel retaining ring, four special metal packing segments and four heat-resisting steel supplemental springs. P-M Metallic Rod Packing is easy to install and requires a minimum of maintenance attention. It's the packing you can count on . . . *truly the packing that packs!* Nearly half a century of high-standard service to the steam power field backs up these statements.

PAXTON-MITCHELL COMPANY

P-M Metallic Rod Packing
P-M Iron and Bronze Castings
2614 Martha Street ★ Omaha 5, Nebraska
Export Department — for Metallic Packing
INTERNATIONAL RAILWAY SUPPLY CO.
30 Church Street ★ New York 7, New York

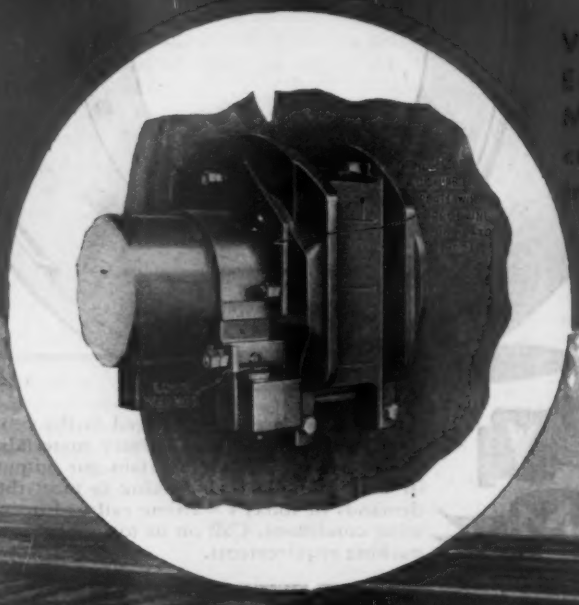
Although we are now engaged in the production of other war necessary materials, we have been able to maintain our output of P-M Metallic Rod Packing to meet the demands of today's wartime railroad operating conditions. Call on us to supply your packing requirements.

★

The Packing that Packs **P-M** *Metallic Rod Packing*

HENN

OIL LUBRICATED
DRIVING JOURNAL
PERFORMANCE



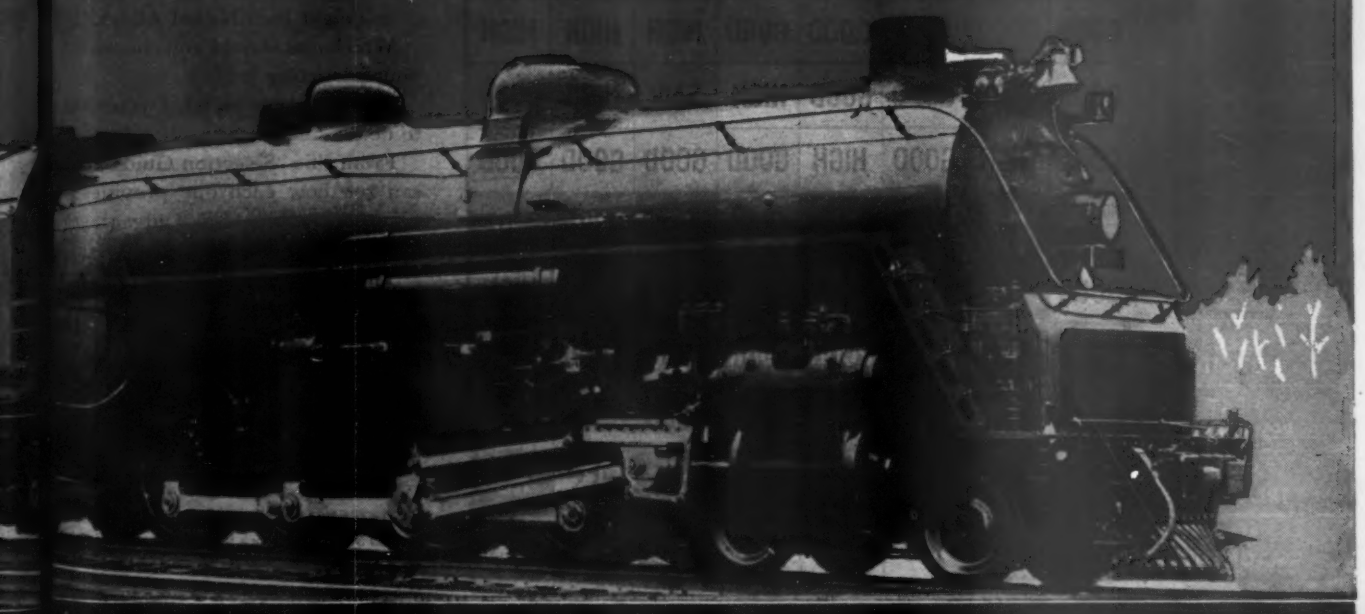
View Showing End Plate and Method of Securing Lubricator in Driving Box.

HENNESSY LUBRICATOR

ESSY

A group of 19 of these engines, fully equipped with Hennessy Mechanical Lubricators on lead truck, driver, trailer and tender journals, is making outstanding records in fast freight service. Some of these locomotives have run 300,000 miles without having any repairs made to driving boxes or journals.

Performance of this kind is very exceptional and savings resulting are certainly worth while.



R CO., Inc.

75 WEST STREET
NEW YORK 6, N. Y.

SUN GLASSES

SKIING GLASSES

SWIMMING GOGGLES

WELDING GOGGLES

IN METALS TOO
It all depends on what you want to do

SELECTION GUIDE TO INCO NICKEL ALLOYS

PROPERTY:	MONEL	"R" MONEL	"K" MONEL	"KR" MONEL	"S" MONEL	NICKEL	"Z" NICKEL	INCONEL
CORROSION RESISTANT	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH
STRENGTH	GOOD	GOOD	HIGH	HIGH	GOOD	GOOD	HIGH	GOOD
TOUGHNESS	GOOD	GOOD	HIGH	GOOD	GOOD	HIGH	HIGH	HIGH
HARDNESS	GOOD	GOOD	GOOD	GOOD	HIGH	FAIR	HIGH	GOOD
MACHINABILITY	GOOD	HIGH	GOOD	HIGH	GOOD	GOOD	GOOD	GOOD
NON-GALLING	NO	NO	NO	NO	HIGH	NO	NO	NO
SPRING PROPERTIES	GOOD	NO	HIGH	NO	NO	GOOD	HIGH	HIGH
ELEC. CONDUCTIVITY	POOR	POOR	POOR	POOR	POOR	GOOD	GOOD	POOR
HEAT RESISTANCE	GOOD	GOOD	GOOD	GOOD	HIGH	GOOD	GOOD	HIGH
HEAT TREATABLE	NO	NO	YES	YES	YES	NO	YES	NO
NON MAGNETIC	NO	NO	YES	YES	YES	NO	NO	YES

When it's a question of finding a metal for some tough job you have in mind there is a quick way to look for a ready answer...

Take a look at the family of Inco Nickel Alloys—strong, hard, corrosion-resisting and absolutely free from rusting, every one of them. Those are the family characteristics of the eight Inco Nickel Alloys.

Which one should you choose for your particular job?

It all depends on what you want to do.

From this "Selection Guide" you can see how each one provides a different combination of advantages for different types of work.

Then write for a copy of our List "B-100" which lists more than 100 technical bulletins and publications that explain the properties, corrosion-resisting characteristics and practical applications of these INCO Nickel Alloys. It is yours for the asking.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

Photo credits (left to right): Ewing Galloway, N. Y.
American Spectacle Co., N. Y.
American Spectacle Co., N. Y.
Black Star, N. Y.

NICKEL INCO ALLOYS

MONEL • "K" MONEL • "S" MONEL • "R" MONEL • "KR" MONEL • INCONEL • "Z" NICKEL • NICKEL • Sheet ... Strip ... Rod ... Tubing ... Wire ... Castings ... Welding Rods (Gas & Electric)

It's what goes on INSIDE *that counts*

Inside an engine, extra flat piston rings deliver important savings

THE FLATTER the ring, the better the seal—and Pedrick rings are so flat that small 2-inch rings can be stacked 6 feet high without tottering, as shown in illustration. It is this kind of precision in each manufacturing operation that enables Pedrick rings to deliver important savings in fuel . . . more power . . . and longer wear.

Furthermore, Pedrick rings stay flat in spite of severe service conditions. Pedrick has developed an exclusive and patented Heat-Shaping process that relieves the stresses set up in the metal by machining operations. Each grain in the metal is set for ring life. There is no distortion or warping in actual service.

These are some of the reasons why Pedrick *precisioneered* rings deliver better performance *inside* an engine as well as in pumps, compressors, and air-operated equipment. In reconditioning diesel engines particularly, you will find that Pedrick rings deliver many extra hours of trouble-free service . . . give better compression . . . and save fuel.

WILKENING MANUFACTURING CO., Philadelphia 42, Pa. *In Canada:* Wilkening Manufacturing Co. (Canada), Ltd., Toronto.

Pedrick

precisioneered **PISTON RINGS**

BUY WAR BONDS AND MORE BONDS

Protect YOUR LOCOMOTIVES' ACHILLES HEELS

WITH N•B•M BRONZE CASTINGS AND BEARINGS

They stand up where stamina counts.

1. Driving box bearings
2. Rod bushings
3. Crosshead shoes
4. Engine truck bearings
5. Knuckle pin bushings
6. Valve and link motion bushings
7. Valve and cylinder rings

Not shown: Frame shoes and wedges
Trailer truck bearings

NBM

NATIONAL BEARING

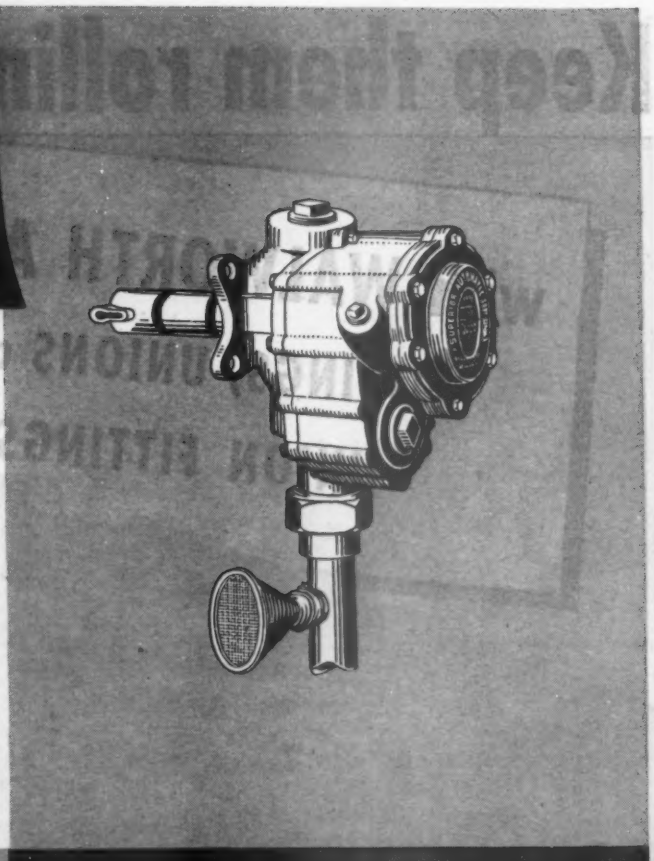
DIVISION

ST. LOUIS • NEW YORK

AMERICAN Brake Shoe COMPANY

PLANTS IN: ST. LOUIS, MO. • PITTSBURGH, PA. • MEADVILLE, PA. • JERSEY CITY, N. J. • PORTSMOUTH, VA. • ST. PAUL, MINN. • CHICAGO, ILL.

SUPERIOR
Automatic
FLUE BLOWER



Locomotives equipped with Superior Automatic Flue Blowers may be kept in continuous service between monthly inspections. That means longer hauls, heavier loads, more economical operation. It means valuable contribution to the nation's transportation problem. By keeping flues and flue sheets clean there is no loss of motive power. And no "down time" for hand cleaning.

Write for literature

SUPERIOR
3-WAY
FLUE ROLLER

This convenient tool sets the record for time-saving and efficiency. In less than a fourth of the time formerly required for the job, the 3-Way Flue Roller in one operation, roll-expands the tube in the sheet, forms a prosser on the water side and flares the end of the tube ready for beading or welding. The rolling action assures even expansion, a tight joint and correctly formed contours.

Literature upon request

SUPERIOR RAILWAY PRODUCTS CORP.
7501 Thomas Boulevard, Pittsburgh, Penna.

R. E. FRICKE	CADE-DWYER COMPANY	ROSS ANDERSON	BEN H. LOBDELL	THE HOLDEN CO.
39 S. La Salle St.	683 Atlantic Avenue	Stuart Court Building	539 W. Olney Avenue	736 St. James St., W.
CHICAGO, ILL.	BOSTON, MASS.	RICHMOND, VA.	PHILADELPHIA, PA.	MONTREAL, CANADA

Keep them rolling in good order

Walworth A.A.R. Union Elbow *Walworth A.A.R. Union* *Walworth A.A.R. Elbow*

The complete line of Walworth A.A.R. Malleable Iron fittings, unions, and union fittings is manufactured to the A.A.R. specifications and includes all types and sizes covered by the specifications.

Walworth A.A.R. Malleable Iron Unions are supplied with female ends or male and female ends, each type in ten sizes from ¼" to 3". 45° and 90° union elbows, union tees, reducing union tees, and union tees with union outlet are also available.

In addition, Walworth manufactures a complete line of Bronze A.A.R. Locomotive Globe and Angle Valves.

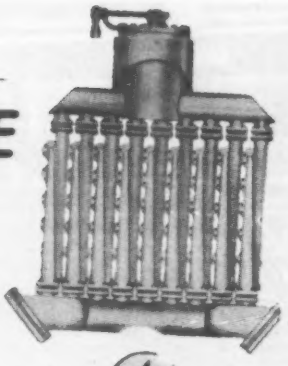
Walworth Catalog 42 describes the entire line of Walworth Valves, Fittings, and Tools, including all A.A.R. types and many others. Catalog 42 gives complete, detailed information on every item, and includes 78 pages of engineering data to assist you in selecting the correct Walworth Valve or Fitting for your specific requirements. Send for your free copy by writing on your company letterhead to Walworth Company, Dept. 220, 60 E. 42nd St., New York 17, N.Y.

12 AWARDS TO 4 PLANTS

WALWORTH
valves AND fittings

WALWORTH ★ VALVES AND FITTINGS ★ ESTABLISHED 1842

THREE PRODUCTS
THAT MAKE THE STEAM LOCOMOTIVE
MODERN



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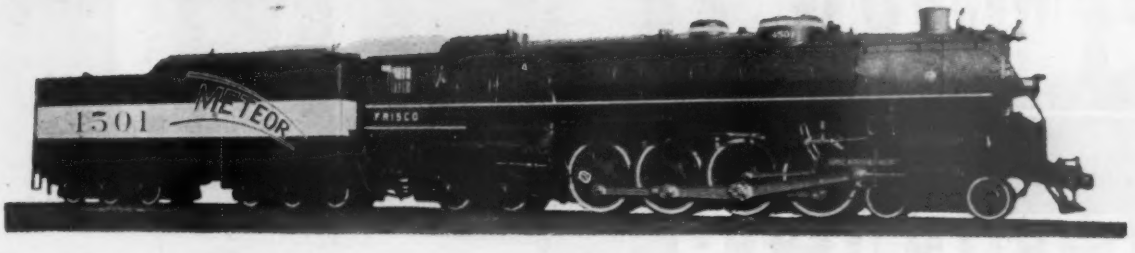

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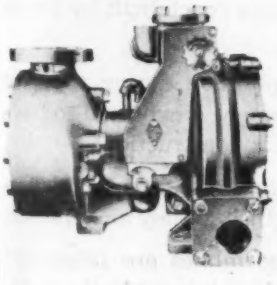

3

FANCY trimmings do not make a steam locomotive Modern. To be really Modern requires the latest in engineering design and development, such as:

1. The C-S Superheater with its modern welded construction; minimum bolted connections; low pressure drop; self-draining, and consistently high superheat temperatures.
2. The Coffin Feed Water Heater with its curved shape that retains original boiler contours, eliminates expansion difficulties without moving parts, and delivery feedwater to the boiler within 9° of the temperature of the saturated exhaust steam in the heater.
3. The Coffin Steam Turbine Centrifugal Pump with its smooth, dependable, non-pulsating action in supplying even the largest capacity boilers at low cost.

If you desire a locomotive that is modern in economy as well as in appearance, we recommend that you investigate these products.

THE J. S. COFFIN, JR., COMPANY
ENGLEWOOD, N. J.

KINDLY SEND DESCRIPTIVE BOOKLET

- ☐ COFFIN STEAM TURBINE CENTRIFUGAL PUMP — INDUSTRIAL — RAILROAD — MARINE
- ☐ COFFIN FEED WATER HEATER — RAILROAD — MARINE
- ☐ C-S. SUPERHEATER — RAILROAD

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COMPANY_____

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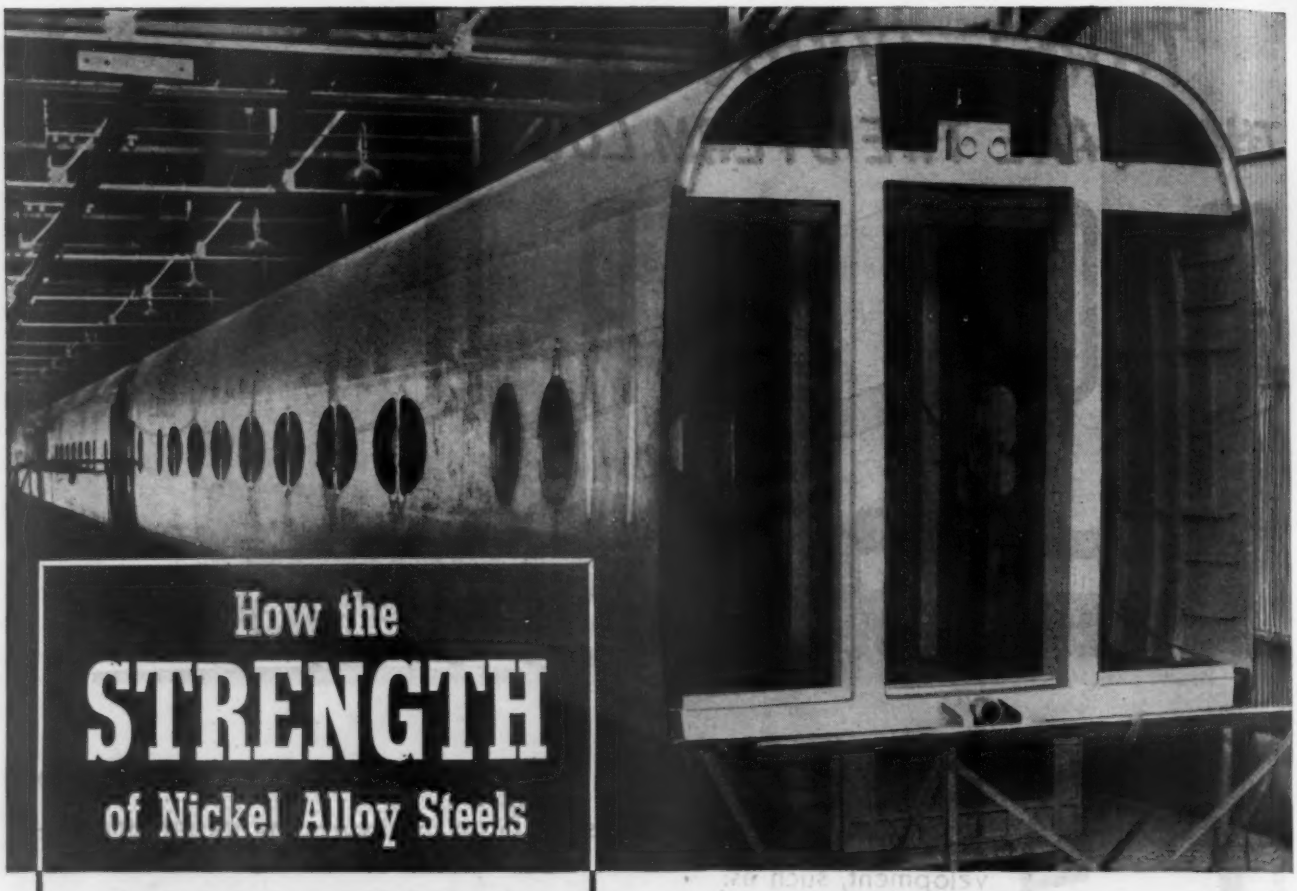
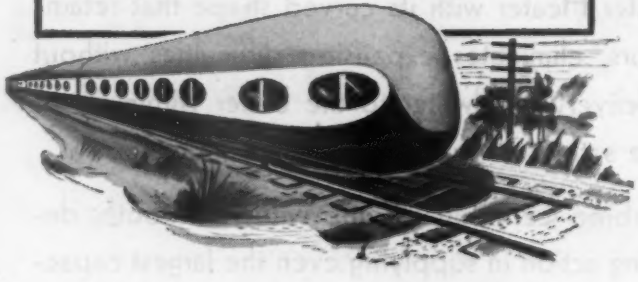


How the STRENGTH of Nickel Alloy Steels improves new types of rolling stock



Road test results have proved that smooth riding qualities can be attained without heavy equipment. The high strength/weight ratios of nickel alloy steels permit considerable safe weight reduction in this new type easy riding car.

Superlative comfort at all speeds... remarkable stability at 100 miles per hour... freedom from vibration... economy in weight...

These characteristics of tomorrow's railway car are exemplified in the new type de luxe coach built by Preco, Inc.

Only a few have been in operation during the past three war-years, but the development is expected to have important influence on future car construction.

Weight reduction... considerable and safe... is effected through use of high strength, low alloy nickel steels.

The entire sides and roof assemblies are fabricated of "Yoloy" a nickel-copper steel... strong, elastic, weldable and corrosion-resistant... produced by Youngstown Sheet and Tube Company.

Floors and center sills are built of "18-8" stainless steel sections. Buffer stems and draft stops are cast of nickel-molybdenum steel, normalized and drawn at 1200° F, supplied by Warman Steel Casting Company.

One of the alloys containing nickel may help *you* reduce bulk and deadweight safely... and to combat wear and corrosion. We invite consultation on the use of Nickel or Nickel alloys in your equipment.

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N.Y.

Tomorrow's
POWER
Today!

It's the Opposed-Piston Diesel Locomotive by

FAIRBANKS-MORSE

A name worth remembering

FROM THE ROCKIES TO THE CUMBERLAND MTS.

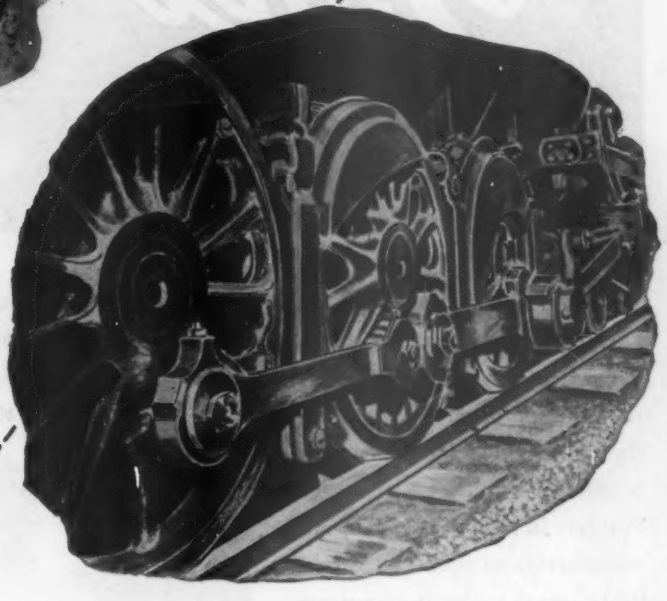
HOLLOW *Flexible* STAYBOLTS

BUY MORE WAR BONDS

Keep 'em Rolling Safely and Economically

FLANNERY BOLT COMPANY
BRIDGEVILLE ★ PENNSYLVANIA

A "Mirror" FINISH IN THE SHOP



Prevents Fatigue Failures ON THE ROAD

A smooth, mirror-like machined surface is of utmost importance in avoiding failure of driving-wheel tires in service. For—a dull, non-reflecting surface indicates a rough finish having thousands of incipient fractures, which, when the tire is shrunk on the wheel and subjected to fatigue, may develop into cracks resulting in tire failure.

A "mirror" finish is obtained by machining at higher speeds with Kennametal—the tough, hard, durable cutting tool material that "peels off" the metal, instead of scraping it away. And—because Kennametal retains its edge, the bore is straight and true, which assures secure, uniform fit of tire to wheel.

On most tire machining jobs, Kennametal-tipped tools will take roughing and finishing cuts simultaneously, at greatly increased cutting speeds, and with exceptionally long tool life. Similar advantages can be obtained in the machining of other parts, made of hard steel, tough, stringy alloys, cast iron, or non-ferrous materials.

Catalog 44 describes Kennametal . . . gives helpful information on tool design and application . . . lists prices that are now only about one-tenth of what they were when Kennametal tools were introduced eight years ago. A copy is yours for the asking.

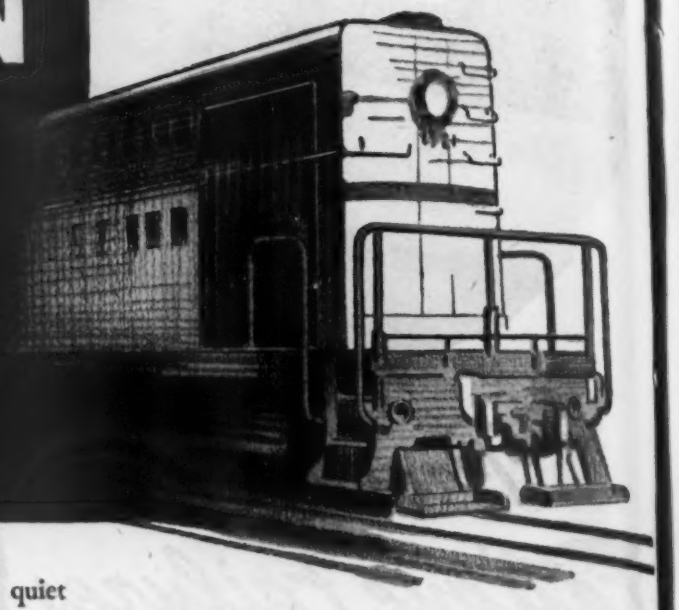
KENNAMETAL

SUPERIOR CEMENTED CARBIDES

TRADE MARK REG. U. S. PAT. OFF.

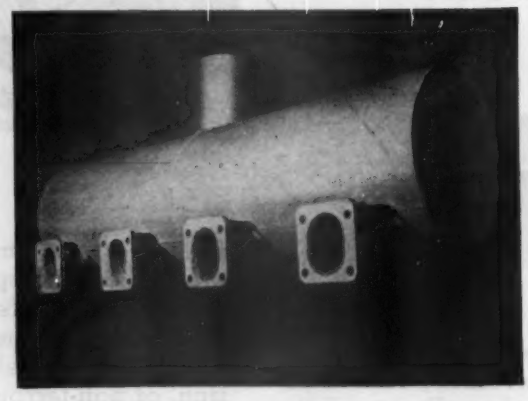
KENNAMETAL Inc., LATROBE, PA.

WHY DIESEL OPERATION IS *Quiet*



MAXIM exhaust manifold silencers quiet Diesel exhausts in railroading today, on the main line and in the switching yards. Both from a practical operating and public relations point of view, good silencing is necessary to make these Diesel powered giants good neighbors.

Pioneers in the development and manufacture of silencers, Maxim brings many years of experience to bear on their construction of silencers for locomotives. Regular exhaust silencers and the manifold silencers that take the place of the conventional exhaust manifold both combine very efficient silencing with the sturdy construction necessary to give long service life and low maintenance. Spark arrestors are also used where a fire hazard exists. Maxim also makes a line of Heat Recovery Silencers which combine effective silencing with the production of hot water or steam for heating purposes. This practical fuel-saving method of heating has many interesting possibilities in railroad operation. Our engineering department will be glad to work with you on possible applications to your particular problems. Heat Recovery Silencer Bulletin WH-101 on request.



ARMY E NAVY

MAXIM

THE MAXIM SILENCER CO. • 65 HOMESTEAD AVE., HARTFORD, CONN.

FOR TOMORROW—*Count on those who are doing the tough job today*

HERE we cut aircraft

piston ring requirements by millions

Because of this efficient Chrome Plating Department our Armed Forces were able to reduce their aircraft piston ring requirements by millions of rings.

WHY

Because the Porus-Krome* wearing surface doubled and redoubled ring life and tripled cylinder life, fighting planes flew thousands of extra miles, were kept in combat instead of in overhaul shops.

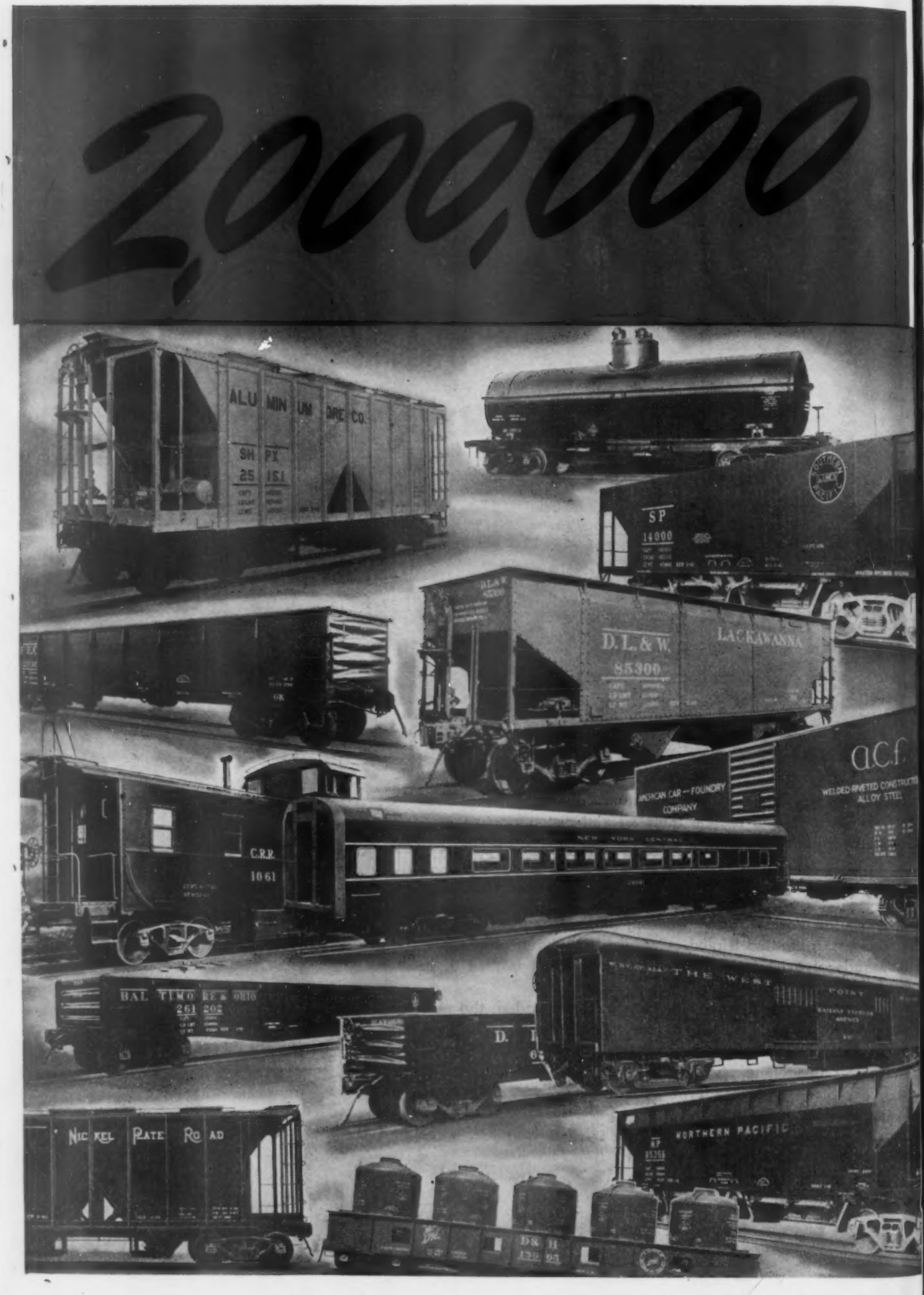
The new things learned, the new facilities added, the new methods developed, all mean that this organization will be better than ever equipped to give you better peacetime piston rings—In Every Size—Of Every Type—For Every Purpose.

Four stars awarded for excellence in war production.

KOPPERS COMPANY, INC.
AMERICAN HAMMERED PISTON RING DIVISION
Baltimore 3, Maryland

KOPPERS
THE INDUSTRY THAT SERVES ALL INDUSTRY

* VAN DER HORST PROCESS


200,000
ALUMINUM ORE CO.
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BAL TIMO RE & OHIO
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NICKEL PLATE ROAD
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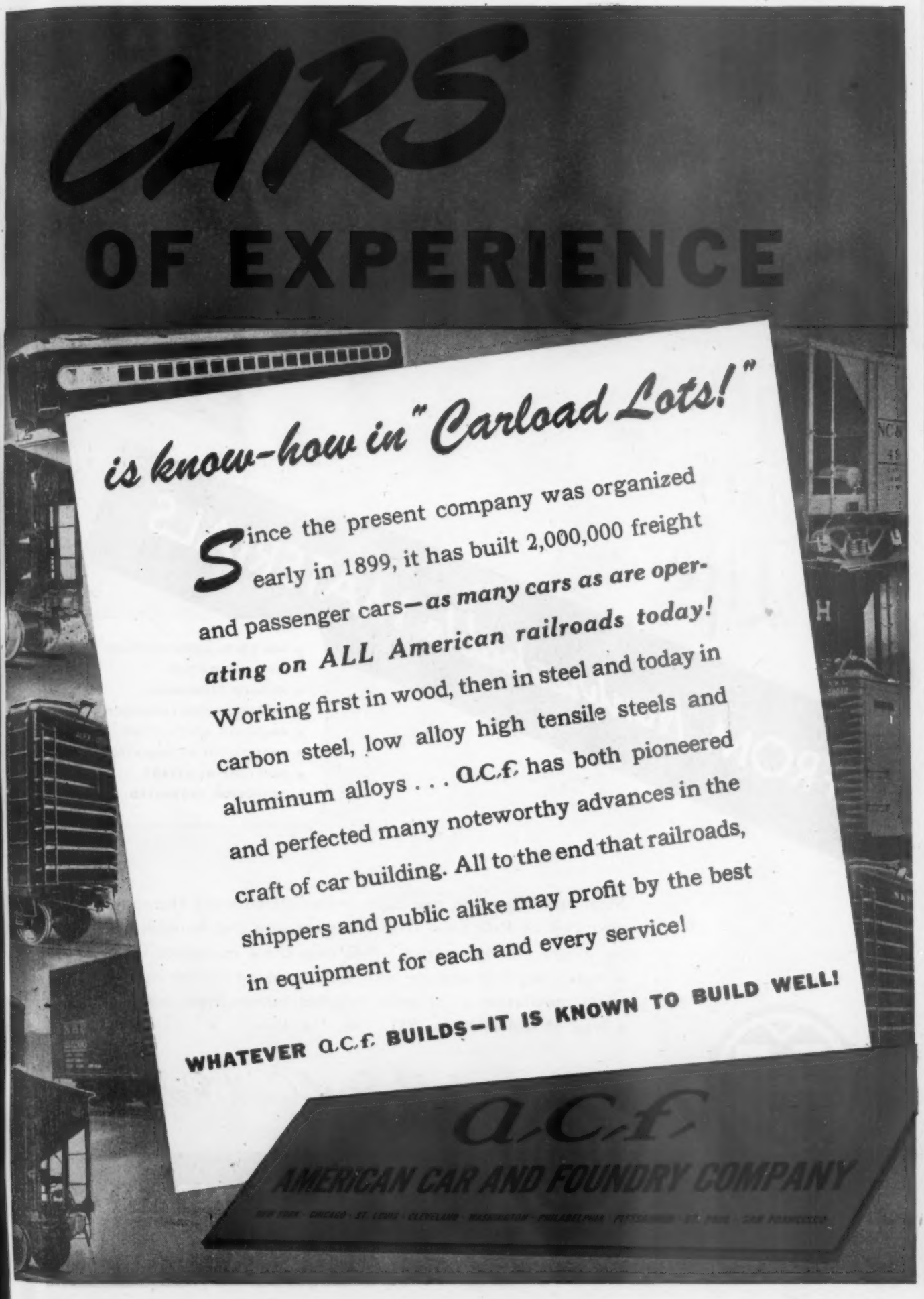
D&H


CARS
OF EXPERIENCE
is know-how in "Carload Lots!"
Since the present company was organized early in 1899, it has built 2,000,000 freight and passenger cars—as many cars as are operating on ALL American railroads today!
Working first in wood, then in steel and today in carbon steel, low alloy high tensile steels and aluminum alloys . . . a.c.f. has both pioneered and perfected many noteworthy advances in the craft of car building. All to the end that railroads, shippers and public alike may profit by the best in equipment for each and every service!
WHATEVER a.c.f. BUILDS—IT IS KNOWN TO BUILD WELL!
a.c.f.
AMERICAN CAR AND FOUNDRY COMPANY

Longer Resistor Life...

FROM Nonbreakable MATERIALS

★ ALL STEEL CONSTRUCTION
★ MICA INSULATION
★ RUGGED TERMINALS
★ PROVISION FOR EXPANSION
★ ADEQUATE VENTILATION
★ UNAFFECTED BY VIBRATION
★ MOISTURE RESISTANT
★ CORROSION PROTECTED

Steel and Mica, the two basic materials entering the construction of P-G Steel Grid Resistors, are the foundation for longer resistor service. P-G uses these materials in a unique design to provide both for expansion and for maximum ventilation. For more detailed information, ask for a copy of Bulletin No. 500 ★ ★ ★ ★ ★ ★

P-G

The Nonbreakable Steel Grid Resistor

THE POST-GLOVER ELECTRIC COMPANY

• ESTABLISHED 1892 •

221 WEST THIRD STREET, CINCINNATI 2, OHIO

TYPICAL DIESEL LUBRICATION PROBLEMS:

5. Liner Wear

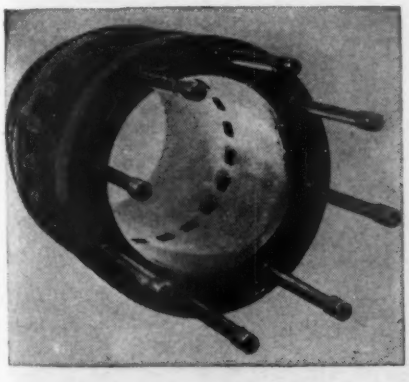
Wear on Diesel liners is commonly concentrated in the high-temperature belt near the combustion chamber. This is largely attributable to the inherent inability of most lubricating oils to "wet" hot metal surfaces.

Unlike spark ignition engines in which a partial vacuum in the combustion space during the intake stroke assists in drawing oil toward the upper compression rings, Diesels operate at or above atmospheric pressure in the combustion space which tends to drive oil away from the rings.

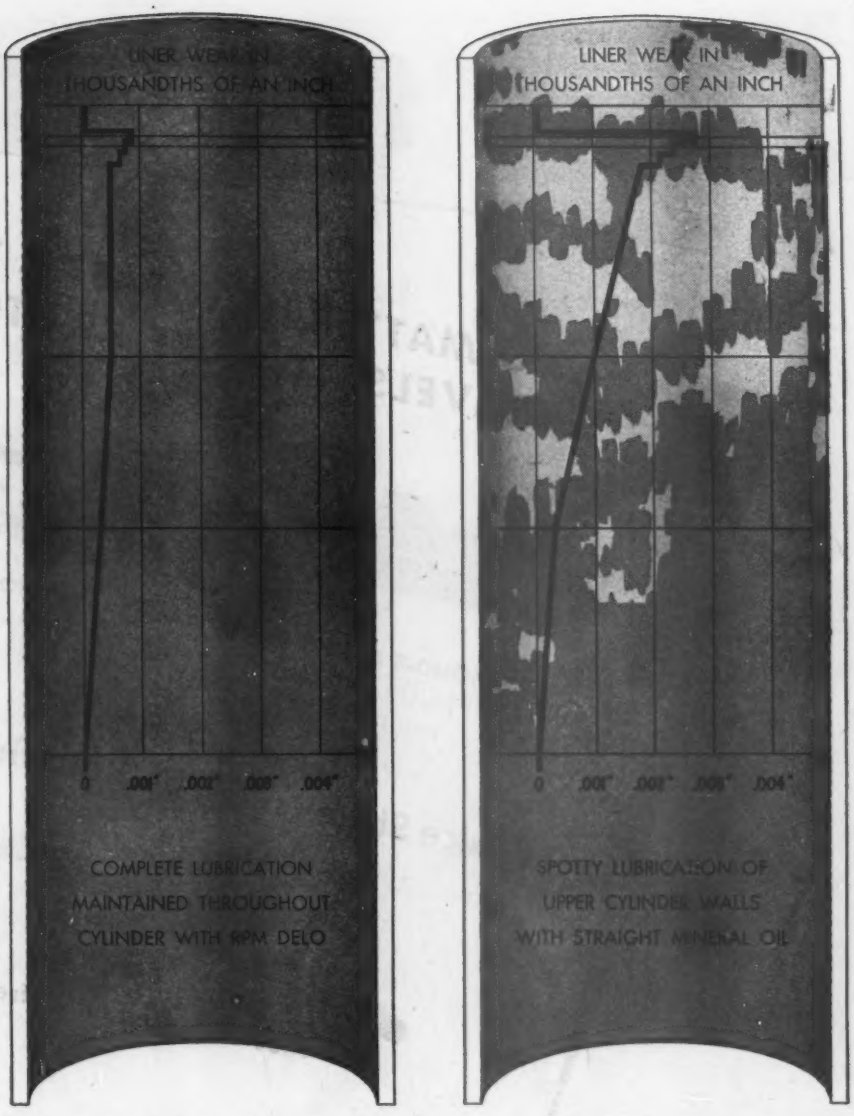
It is imperative then—to prevent relatively dry operation in the top piston ring high-temperature area—for the lubricant to have high-temperature adhesion characteristics.

To achieve this high adhesion factor under all operating conditions in RPM DELO Diesel Engine Lubricating Oil, a special compounding material was added. With this additive, RPM DELO will not run away from hot surfaces, thus preventing metal-to-metal contact on hot-running engine parts.

A typical example of the effectiveness of RPM DELO in preventing liner wear is offered by the Chicago, Rock Island and Pacific Railroad. One of its "Rocket" Diesel powered locomotives ran 157,076 miles on RPM DELO without an oil change, with liner wear of only .001 in.



Liner from Rock Island "Rocket" engine showing wear of only .001 in. after 157,076 miles on RPM DELO without an oil change.


LINER WEAR IN THOUSANDTHS OF AN INCH
0 .001" .002" .003" .004"
COMPLETE LUBRICATION MAINTAINED THROUGHOUT CYLINDER WITH RPM DELO
LINER WEAR IN THOUSANDTHS OF AN INCH
0 .001" .002" .003" .004"
SPOTTY LUBRICATION OF UPPER CYLINDER WALLS WITH STRAIGHT MINERAL OIL

These charts of one of the tests required by the Army in certifying oil for use in combat equipment, graphically illustrate (right) marked increase of liner wear in upper cylinder zone due to inability of straight mineral oil to provide full lubrication of this high-temperature area; and (left) reduction of liner wear by ability of RPM DELO to stick to these hot spots.

Other causes of liner wear minimized by RPM DELO include:

1. Corrosion caused by carbonic and other acids at low temperatures.
2. Scuffing of liners from rocking of piston rings in worn grooves.
3. Scoring and scratching of liners due to stuck piston rings.

Reducing liner wear to a remarkable degree is but one of RPM DELO's advantages in solving Diesel engine maintenance problems. Its other properties include: The ability of RPM DELO to eliminate ring sticking, to stop excessive deposits on rings and ports, and to prevent bearing corrosion.

RPM DELO has world-wide distribution and is marketed under the following names: RPM DELO, Caltex RPM DELO, Kyso RPM DELO, Signal RPM DELO, Sohio RPM DELO, and Imperial RPM DELO (concentrate). Ask your Diesel engine manufacturer or distributor for the RPM DELO supplier in your vicinity.

RPM DELO

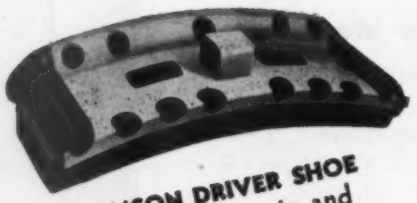
Write on your letterhead for free booklet on RPM DELO, *Standard of California, Dept. T-12, San Francisco, California*

STANDARD OF CALIFORNIA

for SAFETY

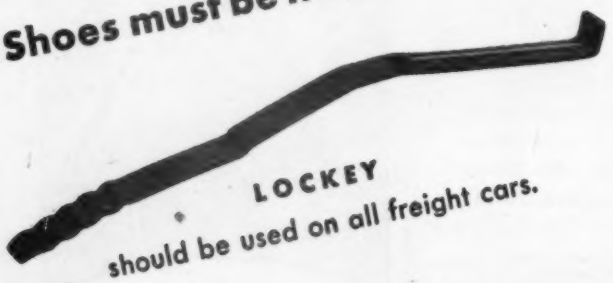
NO MATTER HOW FAST A TRAIN TRAVELS, IT MUST BE STOPPED

DIAMOND-S BRAKE SHOE
for all freight and passenger equipment.



SAMSON DRIVER SHOE
for steam, electric and diesel locomotives.

Brake Shoes must be held firmly in place.



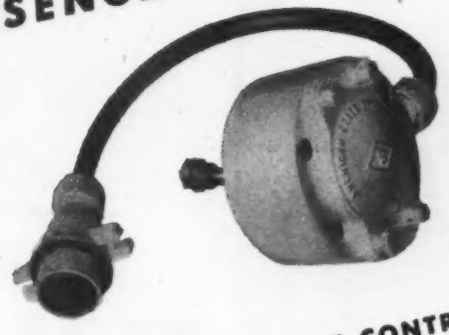
LOCKEY
should be used on all freight cars.

AMERICAN **Brake Shoe** COMPANY

BRAKE SHOE AND CASTINGS DIVISION

and Economy . . .

PROTECT YOUR HIGH SPEED PASSENGER EQUIPMENT



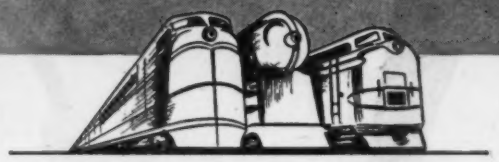
AMERICAN BRAKE SHOE CONTROLLER

gives the shortest stops possible
with no damage to wheels.

230 PARK AVENUE, NEW YORK 17, N. Y.

3844

AMERICA'S SPEEDIEST STREAMLINED TRAINS



RIDE ON HOUDAILLE SHOCK ABSORBERS

● First ten years ago . . . first *today*. That's the Houdaille* record for developing special railroad hydraulic shock absorbers to insure superb riding comfort . . . stability . . . *safety*.

America's first lightweight, high-speed train pioneered the use of double-acting Houdaille instruments in November, 1934. Today Houdaille is stabilizing and cushioning the operation of the most famous streamlined trains in the country.

Improved Houdaille railroad instruments for vertical, lateral and journal box control are now ready for post-war plans. Ask us about them.

HOUDE ENGINEERING DIVISION OF
HOUDAILLE-HERSHEY CORPORATION
MAKERS OF HYDRAULIC CONTROLS
Buffalo 11, New York

*Pronounced—Hoo-dye

To Help You Turn the Page

America's Panorama of Transportation has thrilling chapters ahead. They will be written and are being written by drawingboard pens, in the hands of modern designers.

Their trains of tomorrow will speed our travel, and keep it luxuriantly relaxing and comfortable . . . with air-conditioning, special car-lighting, noise elimination, and more.

As you contemplate these and other innovations, there's probably a Dayton V-Belt engineer "at home" in your own yard, who is there precisely to help you, especially with problems of design in power-transmission.

He's there to give you every advantage of Dayton V-Belt drives, with V-Belts that are strong, smooth-running; tough, hard-gripping, and longer lasting and more weather and water and oil-resistant than any other V-Belts before.

He's there to give you every benefit of Daytons 40 years of specialized experience in both natural and synthetic rubber, every bit of helpful information discovered or developed by Daytons own Railway Division . . . the kind of service that's never reflected in "price."

So as you prepare to "turn the page" for progress in your yard, look up your Dayton man. He will help you do it, and make it well worth your while.

THE DAYTON RUBBER MANUFACTURING CO.
DAYTON 1, OHIO
Specialized Manufacturer for the R.R. Industry

V-Belts by Dayton Rubber

The Mark of Technical Excellence in Synthetic Rubber

★ KEEP ON BUYING WAR BONDS ★

Oliver WATERTIGHT Bolts

ASSEMBLE FASTER
PREVENT BOARD SPLITTING
SELF-SEALING

SUCCESSFULLY USED TO SPEED CAR CONSTRUCTION AND REPAIR

Made in all popular sizes, Oliver Watertight Bolts are widely used by railroad car building and repair crews today.

- **For weather-sealed flush fastening in freight car construction.**
- **Eliminate costly counterboring.**
- **Head is heaviest where wear is greatest.**
- **Corrugated neck grips firmly without splitting boards.**
- **Raised rings on underside of head keep moisture out.**

The practical advantages of Oliver Watertight Bolts, listed above, are the result of experience and cooperation between railroad men and Oliver engineers.

Write for Oliver Railroad Catalog. Covers the complete line.

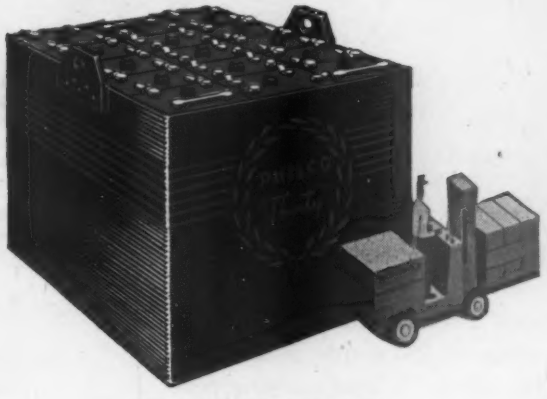
OLIVER
IRON AND STEEL
Corporation

SOUTH TENTH AND MURIEL STS. · PITTSBURGH 3, PENNA.

Makers of Bolts, Nuts, Rivets and other headed and threaded products

LET PHILCO HELP REDUCE YOUR POST-WAR COSTS

Philco is ready, *today,* with the advanced high-capacity battery performance and long-life economy you'll need in your post-war operations. The complete Philco post-war line includes modern Storage Batteries for all motive power and stationary needs. It will save you dollars in depreciation, up-keep and maintenance costs to specify Philco. Let us send you the latest Philco Battery catalogs of types for your special requirements. PHILCO CORPORATION, Storage Battery Division, Trenton 7, New Jersey.



THE NEW PHILCO "THIRTY"

An outstanding post-war product for industrial trucks is the new Philco "Thirty" Storage Battery that gives 30% longer life and is identified by its distinctive red top. It is now available in certain types and limited quantities.

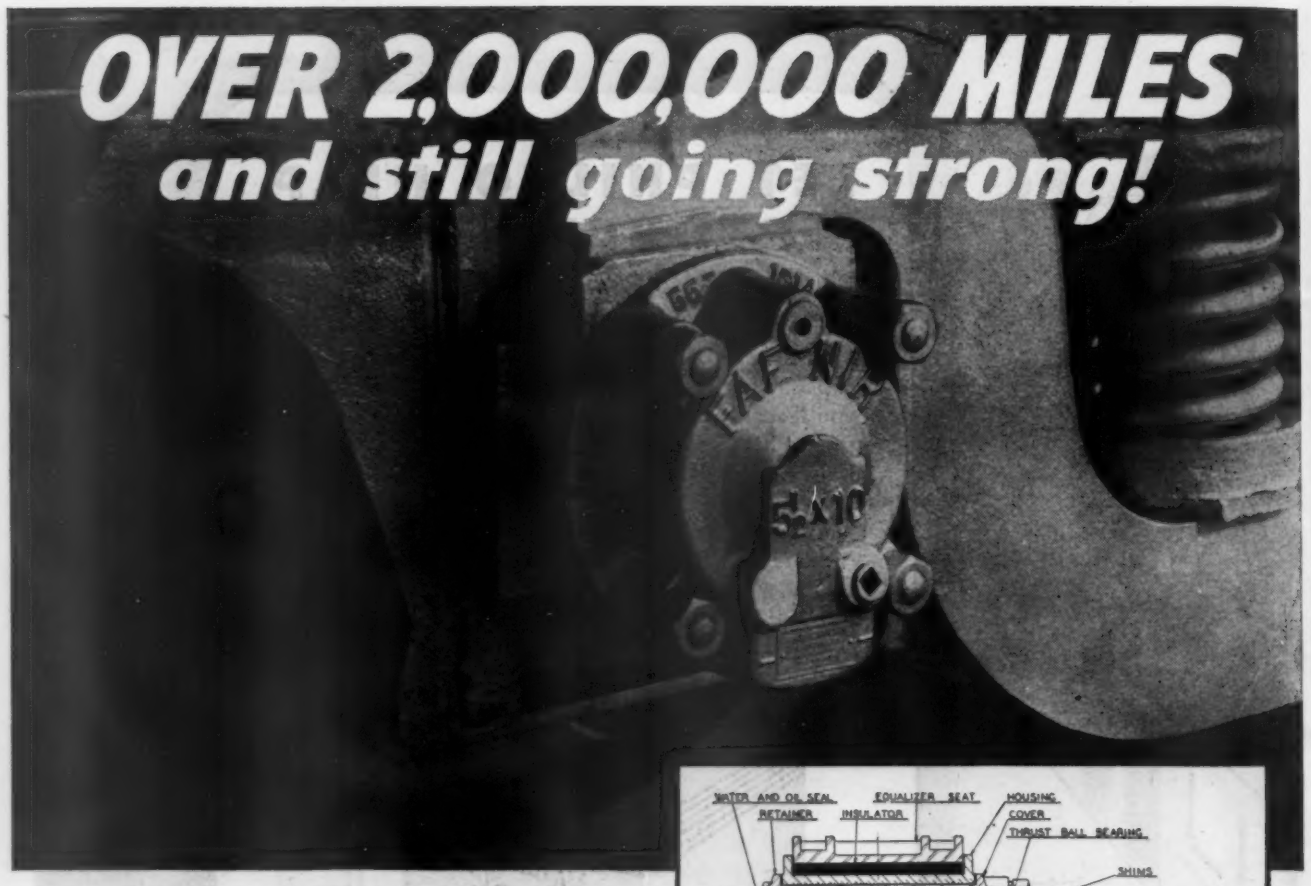
Philco Railroad Car Lighting and Air Conditioning Battery

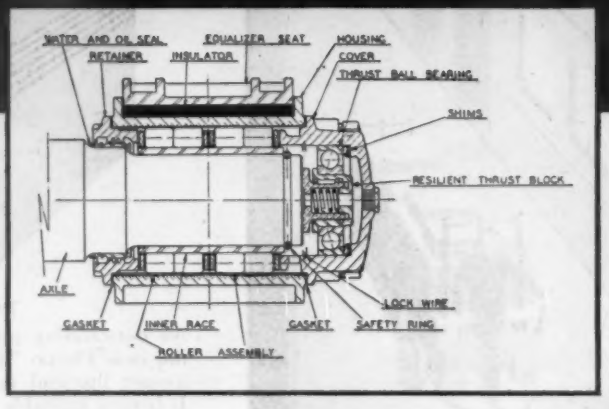
Philco Railroad Diesel Starting Battery

Specify PHILCO STORAGE BATTERIES

For 50 years a leader in Industrial Storage Battery Development

OVER 2,000,000 MILES
and still going strong!





Fafnir Ball and Roller Journal Bearings are speeding to new endurance records on many of America's crack trains. Precision-made to modern railroad standards, compact and sturdy, Fafnirs are paying off minute by minute, in load carrying performance and maintenance costs. They seal out dirt and water . . . seal in lubrication . . . set power free from friction!

One half pound of grease every 60 days! That's the maintenance figure on grease-lubricated Fafnirs – and oil-lubricated Fafnirs are almost as economical. They are readily adaptable to standard AAR pedestal openings . . . need no removal of inner rings at wheel tuning periods. The Fafnir Bearing Co., New Britain, Connecticut.

BUY WAR BONDS AND STAMPS

FAFNIR BALL & ROLLER JOURNAL BEARINGS

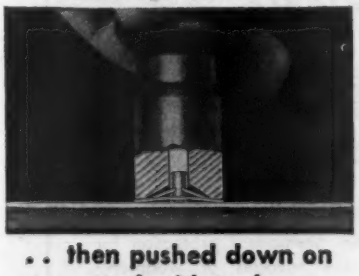
REDUCE STARTING LOADS UP TO 90% . . . CUT MAINTENANCE COSTS TWO-THIRDS

ONE OF A SERIES PORTRAYING "THE SPEED NUT FAMILY OF FASTENERS"

PUSH-ON SPEED NUT

JUST A *Push* AND IT LOCKS!

SPEED NUT is started over stud by hand . . .



. . then pushed down on stud with tool.

Parts are held together with firm spring tension lock.

● It's just as simple and easy as that! For this unique spring steel fastener needs only to be *pushed* over rivets, nails, tubing, wire, integral die cast or plastic studs to lock parts firmly together. Threads are unnecessary because the spring prongs of the nut provide a friction *lock* on even the smoothest of chrome surfaces.

But easy attachment is not the only advantage gained by using Push-On type SPEED NUTS. Costly threaded inserts, drilling and tapping are eliminated — molding costs reduced — assembly speeded up — and vibration loosening prevented. These fasteners are available in many sizes and shapes . . . rectangular, square, round, or they may be specially designed to fit your particular requirements.

If you want to improve the attachment of name plates, emblems, trim strips, grilles, or other light-weight parts, write now for samples of Push-On type SPEED NUTS, giving *stud diameter* and any other pertinent assembly details.

TINNERMAN PRODUCTS, INC.
2029 FULTON ROAD, CLEVELAND 13, OHIO
In Canada: Wallace Barnes Co., Ltd., Hamilton, Ontario
In England: Simmonds Aerocessories, Ltd., London

THE BASIC PRINCIPLE of Spring-Tension Lock is Embodied in all Speed Nut Designs

Speed Nuts PATENTED *Trade Mark Reg. U. S. Pat. Off.

FASTEST THING IN FASTENINGS

THE INSULATION IS
WOVENSTONE

THE PASSENGER IS COMFORTABLE

Wovenstone provides permanent protection for steam lines from the ravages of weather—maintains highest possible temperatures from the locomotive back to the last car of the longest trains. Wovenstone will not loosen, sag or shake down—remains firm and snug against the pipe at all times. Can be removed and reapplied without loss of original efficiency.

UNION ASBESTOS
MEANS PROGRESS IN INSULATION
AND RUBBER CO.

310 S. MICHIGAN AVE., CHICAGO 4
NEW YORK SAN FRANCISCO

KEEP ON BUYING WAR BONDS!

"I TOLD You! —it's a Job for Aeronautical Products, Inc."

WHEN your machining specifications say "Tolerance .0005," to us it means five ten-thousandths of an inch, and not a whisper more, or less. Tolerances like these, and much finer, call for experience, skill and machinery of vast proportion. So, if YOUR post-war assemblies require precision machining in volume, right from engineering through to the final inspection, *it's a job for Aeronautical Products, Inc.!* Here in one *complete* organization is everything your job needs. Controlled responsibility . . . no buck-passing. You get your answers straight from the shoulder and backed with performance. If our set-up sounds good to YOU, ask your secretary to write our Executive Sales Offices, Detroit, for an impressive list of plant equipment and *complete* facilities.

★ BUY MORE BONDS ★

● *THE SUCCESS of The Aeronautical Products, Inc. Helicopter, designed and built by our own craftsmen, promises new accomplishments in the post-war age of flight!*

AERONAUTICAL PRODUCTS, Inc.

DETROIT PLANT
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Save Tires and Rails

Illustration Showing 2-C-77-D Type Flange Oiler for Steam Locomotives

with SWANSON Flange Oilers

The Swanson Flange Oiler reduces wear on tires, rails and switch points, resulting in increased locomotive availability, reduction in the number of derailments, and lower maintenance costs on motive power and track.

100% automatic, the Swanson Flange Oiler feeds only when the engine is in motion and automatically stops when the engine is at rest. It is of simple, sturdy construction, requiring practically no attention except filling. The oil delivery shoe confines the oil to the flange and prevents spreading to the tread of the wheel.

Join over 70 other roads who have found that their thousands of Swanson Flange Oilers pay big dividends.

We manufacture Flange Oilers suitable for all types of steam locomotives and Diesel switchers.

Write today for full particulars

THE SWANSON COMPANY

2522 W. Lawrence Ave. **Chicago, 25, Ill.**

SOUTHERN PACIFIC LINES

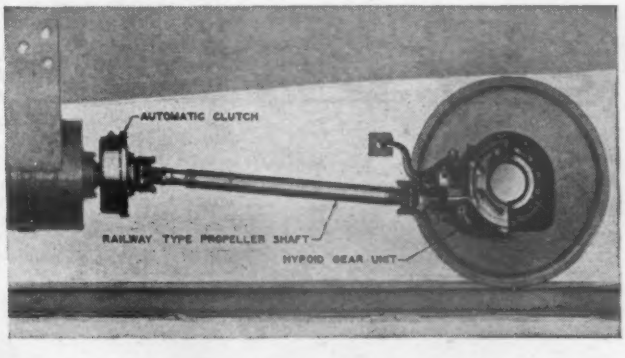
uses the SPICER *Positive* Generator Drive

The Southern Pacific Coast Daylight

● The Southern Pacific Coast Daylight is but one of the nation's many crack trains using Spicer Positive Generator Drives. More than 2000 of these dependable Generator Drives are in use on 27 different American railroads, for lighting, air-conditioning and refrigeration equipment.

The Spicer Positive Railway Generator Drive consists of a very simple application of long-lived hypoid gear and pinion mounted on the standard axle. The drive from the gears is positive and constant, through Spicer Universal Joints and Propeller Shaft to the Spicer Automatic Clutch mounted between the generator and the propeller shaft. This automatic clutch completely absorbs all shocks and disconnects the drive line in case of excessive overload, and also completely disconnects the generator drive at speeds below 8 miles per hour, eliminating shock loads when cars are being shunted, also preventing any additional load on the locomotive when starting. It also automatically permits motoring of generator for electrical inspection, and driving of generator by standby motor.

Spicer Positive Railway Generator Drives can be quickly and economically adapted to new designs and reconditioning jobs. Spicer has 42 years of experience available to help you with your individual drive problems—write for further details and literature.



Exterior and cross-section view of Spicer Positive Generator Drive

42 YEARS OF Spicer SERVICE

Positive Generator Drive

Manufactured, Sold and Serviced by

Spicer Manufacturing Corporation, Toledo, Ohio

Postwar trains may use G-E lighting like this to create the kind of restful atmosphere that helps passengers relax and enjoy their travel. G-E fluorescent provides generous light in the aisle and over seats for reading.

GOOD LAMPS ARE THE HEART OF GOOD LIGHTING

Buy G-E!

Did You Know... **Every G-E Mazda Lamp is Lighted Twice Before It's Packed!**

Yes . . . every single G-E lamp, not just a few samples here and there. This is but one of the more than 480 tests and inspections to which G-E Mazda lamps are subjected.

Now that you can buy as many G-E lamps as you need, look for the G-E monogram on the lamps you buy. Remember . . . it is the constant aim of General Electric research to make lamps bearing this mark GE . . .

Stay Brighter Longer

G-E MAZDA LAMPS

GENERAL ELECTRIC

BUY WAR BONDS AND HOLD THEM

REBUILT ~~AS GOOD~~ AS NEW *better than because they added Long Life with Alcoa Aluminum*

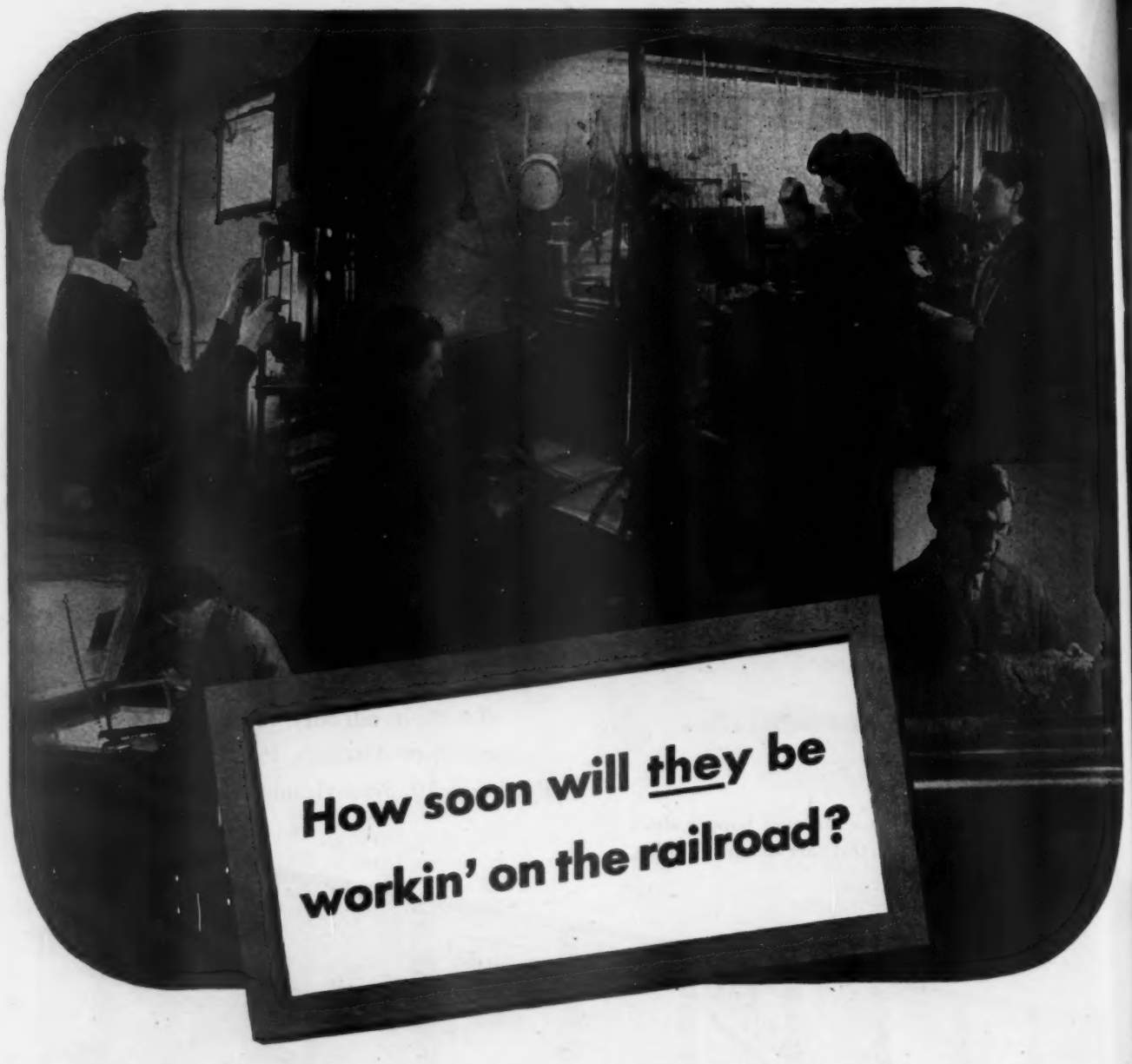
This section of an aluminum hopper sheet weighs only 58 lbs. Old part weighed 174 lbs.

Better than new because all plates in contact with the lading now in this Burlington hopper car are Alcoa Aluminum. They're highly resistant to the corrosive attack of high sulphur coals this car is called upon to carry. Experience elsewhere, with aluminum in hopper cars, indicates a useful life of thirty years or more for this rebuilt car.

To car designers and users who are wondering about ways of lengthening the life of rolling stock, of cutting maintenance and reducing dead weight, Alcoa engineers offer their advisory services. ALUMINUM COMPANY OF AMERICA, 1929 Gulf Building, Pittsburgh 19, Pennsylvania.

ALCOA FIRST IN **ALUMINUM**

ALCOA ALUMINUM



THESE trained men and women in Hycar's Customer Service Laboratory are anxious to go to work for you—helping you find ways to modernize, to increase economy, improve efficiency and reduce maintenance. These results have been gained in railroading as well as in all industry where synthetic rubber parts—made of Hycar and requiring any combination of the properties listed in the box at the right—have been employed.

Hycar synthetic rubbers are particularly valuable in applications where resistance to oil, sunlight, abrasion and wear—combined with permanent resilience—are required.

Hycar Chemical Company makes no finished rubber parts, furnishing only the crude synthetic rubber to fabricators. However, our Technical Service Staff will be pleased to work with you on any of your applications, even the most difficult. You'll find—as have so many men in industry—that it pays to use Hycar when the going gets tough. *Hycar Chemical Company, Akron 8, Ohio.*

Check These Superior Features of Hycar

1. **EXTREME OIL RESISTANCE**—insuring dimensional stability of parts.
2. **HIGH TEMPERATURE RESISTANCE**—up to 250° F. dry heat; up to 300° F. hot oil.
3. **ABRASION RESISTANCE**—50% greater than natural rubber.
4. **MINIMUM COLD FLOW**—even at elevated temperatures.
5. **LOW TEMPERATURE FLEXIBILITY**—down to —65° F.
6. **LIGHT WEIGHT**—15% to 25% lighter than many other synthetic rubbers.
7. **AGE RESISTANCE**—extremely resistant to checking or cracking from oxidation.
8. **HARDNESS RANGE**—compounds can be varied from extremely soft to bone hard.
9. **NON-ADHERENT TO METAL**—compounds will not adhere to metals even after prolonged contact under pressure. (Metal adhesions can be readily obtained when desired.)

Hycar

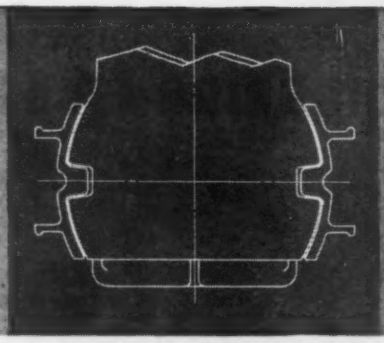
Reg. U. S. Pat. Off.

LARGEST PRIVATE PRODUCER OF BUTADIENE TYPE

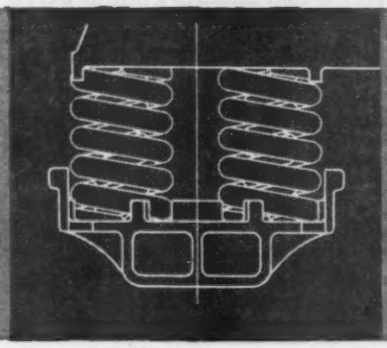
Synthetic Rubbers

Free—write for your copy of the new pocket-size Hycar Glossary of commonly used synthetic rubber terminology.

THE A·S·F *Basic* FREIGHT-CAR TRUCK



Here is a rugged truck of simple design. It combines all the essentials of a good freight-car ride with the low-maintenance benefits of simple construction. To illustrate, the A. S. F. Basic Freight-Car Truck is held together by tongues on the side frame columns that mesh with grooves in the bolster. Curved surfaces between side frame columns and bolster minimize column wear, eliminate binding, and assure generous contact areas to provide dependable operation.



Of simple construction, too, is the flanged spring seat that is an integral part of the side frame. Every side frame and bolster meets all A. A. R. strength requirements. And for greater utility, the Basic Truck can be used with either all-coil spring groups or combination snubber-coil spring groups. The Basic Truck is a safe freight-car truck.

AMERICAN STEEL FOUNDRIES

CHICAGO

MINT-MARK OF FINE CAST STEEL

IT'S A PRODUCTION PLUSSER!

Time was when this manufacturer of magneto housings used slotted screws *and* helical inserts to fasten heads to withstand flight vibrations. Though expensive, this laborious, 2-step hand operation never produced completely vibrationless fastenings.

IT'S A COST REDUCER!

By switching to Phillips Recessed Head Screws, this manufacturer turned a slow-motion process into a fast, 1-step power operation, got a truly vibration-proof fastening. He also sliced fastening material costs about 71%, assembly costs correspondingly!

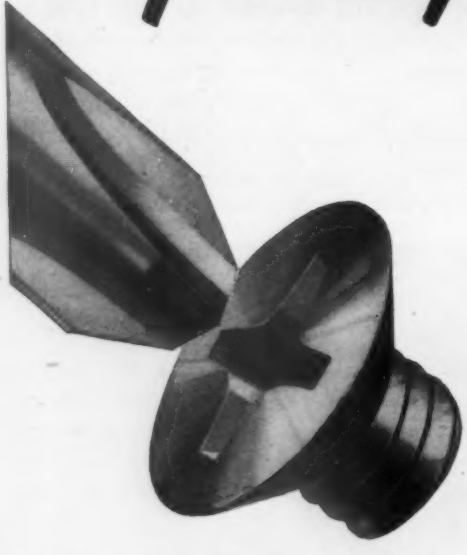
IT'S A STRENGTH BUILDER!

Besides being more efficient from assembly and cost angles, Phillips Screws are better from the design angle. Engineered to stand heaviest driving pressures, they take *any* load you need to impart product strength and rigidity.

IT'S AN ORDER GETTER!

From the sales angle, too, Phillips Screws are in a class by themselves. They snap up appearance of any product . . . make it stronger . . . and banish the burred screw heads that mar smooth surfaces, snag clothing, sabotage sales.

It's Phillips — the engineered recess!



In the Phillips Recess, mechanical principles are so correctly applied that every angle, plane, and dimension contributes fully to screw-driving efficiency.

. . . It's the exact pitch of the angles that eliminates driver skids.

. . . It's the engineered design of the 16 planes that makes it easy to apply full turning power – without reaming.

. . . It's the "just-right" depth of recess that enables Phillips Screw Heads to take heaviest driving pressures.

With such precise engineering, is it any wonder that Phillips Screws speed driving as much as 50% – cut costs correspondingly?

To give workers a chance to do their best, give them faster, easier-driving Phillips Recessed Head Screws. Plan Phillips Screws into your product now.

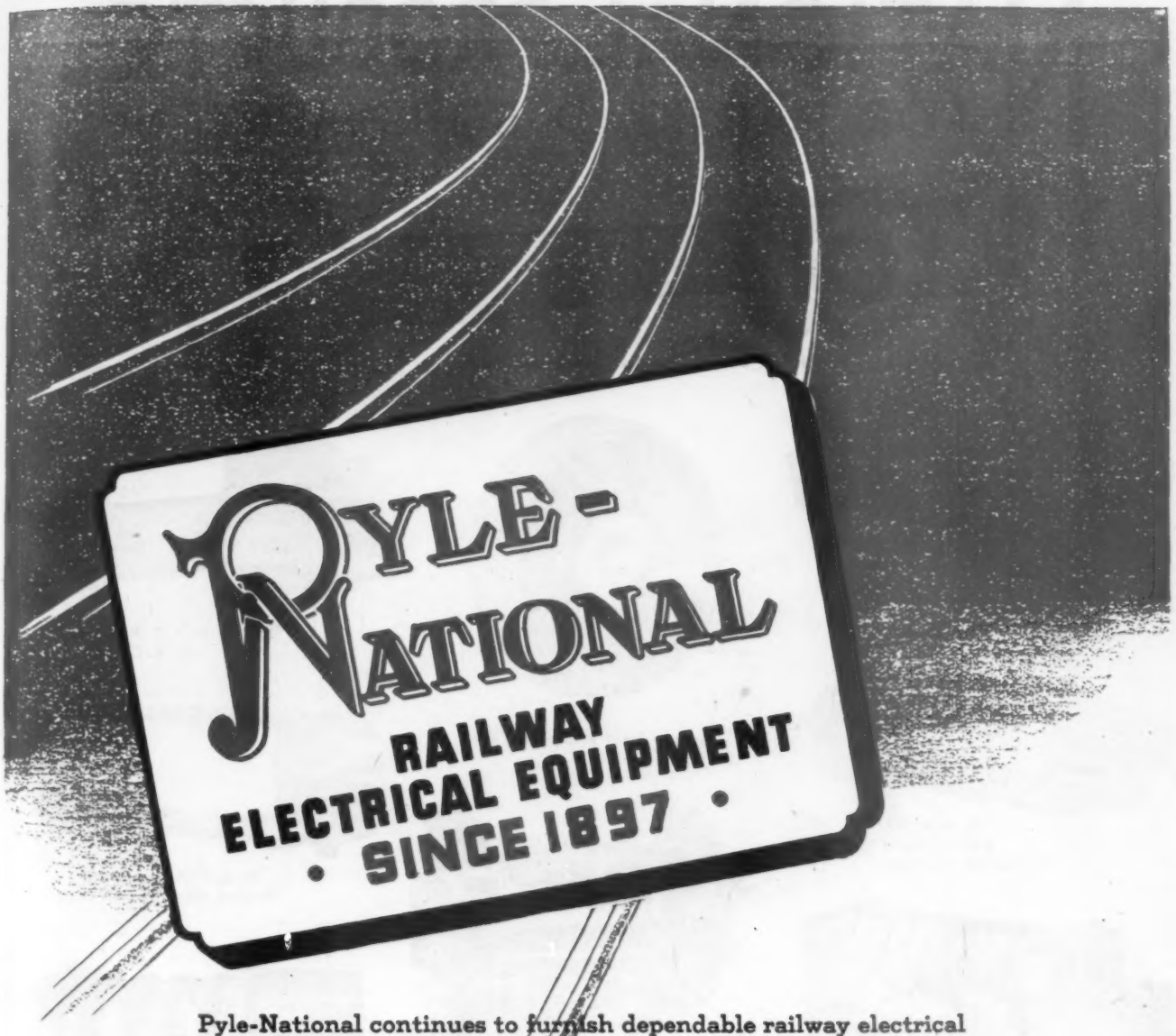
PHILLIPS *Recessed Head* SCREWS

WOOD SCREWS • MACHINE SCREWS • SELF-TAPPING SCREWS • STOVE BOLTS

Made in all sizes, types and head styles

24 SOURCES

American Screw Co., Providence, R. I.
Atlantic Screw Works, Hartford, Conn.
The Bristol Co., Waterbury, Conn.
Central Screw Co., Chicago, Ill.
Chandler Products Corp., Cleveland, Ohio
Continental Screw Co., New Bedford, Mass.
The Corbin Screw Corp., New Britain, Conn.
General Screw Mfg. Co., Chicago, Ill.
The H. M. Harper Co., Chicago, Ill.
International Screw Co., Detroit, Mich.
The Lamson & Sessions Co., Cleveland, Ohio
Manufacturers Screw Products, Chicago, Ill.
Milford Rivet and Machine Co., Milford, Conn.
The National Screw & Mfg. Co., Cleveland, Ohio
New England Screw Co., Keene, N. H.
Parker-Kalon Corp., New York, N. Y.
Pawtucket Screw Co., Pawtucket, R. I.
Pheoll Magufacturing Co., Chicago, Ill.
Reading Screw Co., Norristown, Pa.
Russell Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Scovill Manufacturing Co., Waterville, Conn.
Shakeproof Inc., Chicago, Ill.
The Southington Hardware Mfg. Co., Southington, Conn.
Wolverine Bolt Co., Detroit, Mich.



Pyle-National continues to furnish dependable railway electrical equipment, in a full range of standard types, designed to meet all railway operating needs. Keeping pace with the advancing requirements of efficient railway operation, Pyle-National not only assures dependability under present-day conditions, but anticipates the needs of future and even more exacting service.

Years of specialized experience enable Pyle-National to contribute effectively to the dependable railroad transportation so valuable to our country today.

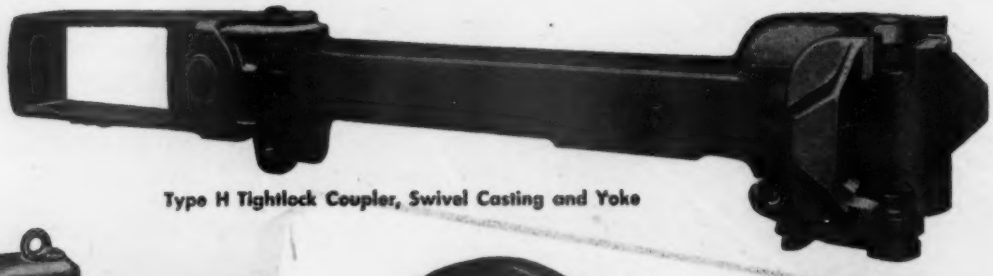
THE PYLE-NATIONAL COMPANY

1334-58 North Kostner Avenue • Chicago 51, Illinois

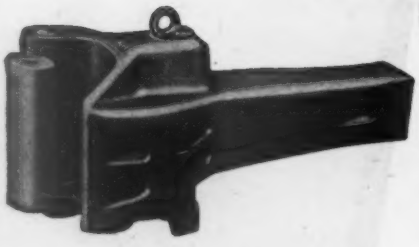
Offices: New York, Baltimore, Pittsburgh, St. Louis, St. Paul.
Export Department: International Railway Supply Co., New York.
Canadian Agents: The Holden Co., Montreal.

Headlights • Turbo-generators • Conduit fittings for locomotive, car, and shop wiring • Cab lighting fixtures • Yard floodlighting • Plugs and receptacles for stand-by air conditioning, battery charging, and other services • Multi-Vent system of air distribution.

NATIONAL PRODUCTS
FOR RAILROAD EQUIPMENT



Type H Tightlock Coupler, Swivel Casting and Yoke



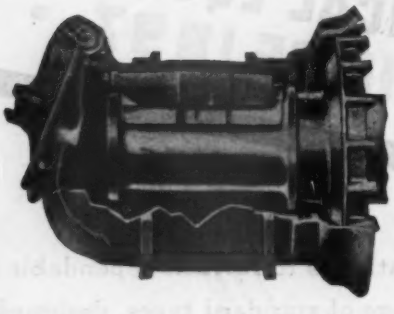
A. A. R. Std. E. Coupler

Naco Spun Steel Car Wheel

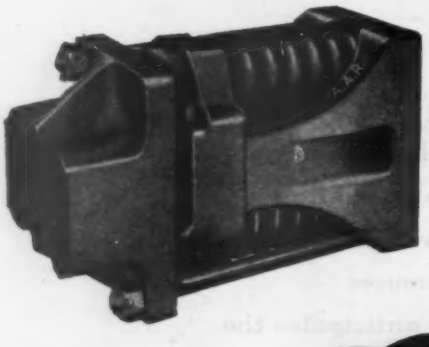
A. A. R. Alternate Std. E. Coupler

A. A. R. Std. Vertical Plane Horizontal Key Yoke

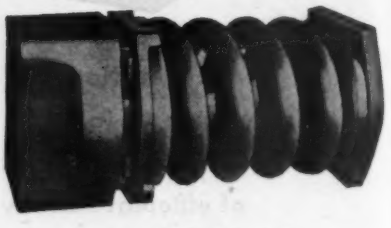
A. A. R. Alternate Std. Vertical Plane Swivel Yoke



National Journal Box with Deflecting Fan and Flexo No. 2 Lid



M-17-A Draft Gear
A. A. R. Approved



M-50-B Draft Gear
A. A. R. Approved

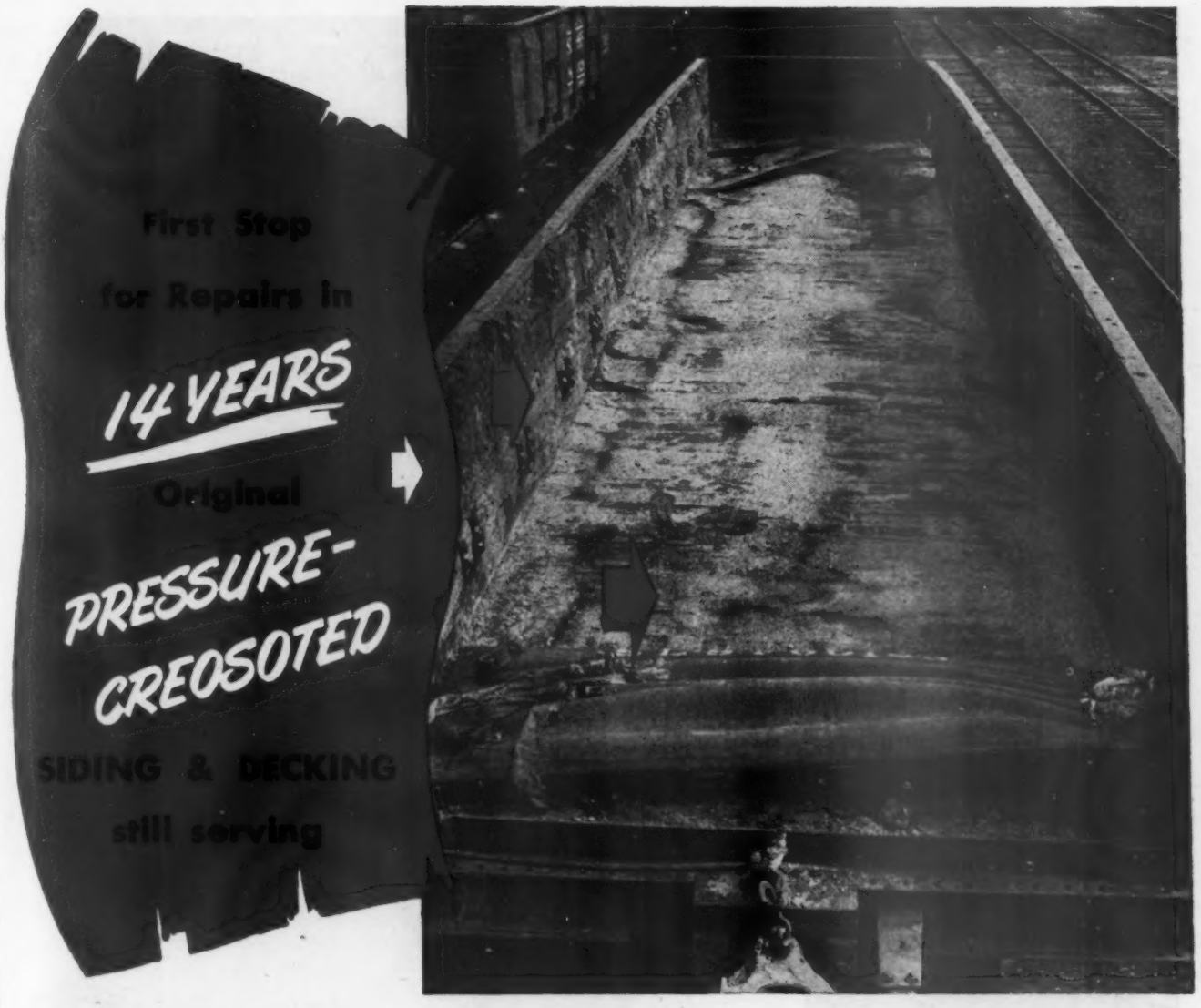
National B-1 Truck with Dual Control

76 YEARS SERVICE To Transportation

NATIONAL MALLEABLE AND STEEL CASTINGS CO.

General Offices: CLEVELAND, OHIO

Sales Offices: New York, Philadelphia, Chicago, St. Louis, San Francisco.
Works: Cleveland, Chicago, Indianapolis, Sharon, Pa., Melrose Park, Ill.



This gondola, built in 1930, is in the shop for its *first major repairs.* All the decking and siding you see is original material, which has lasted for 14 years under rough usage—and still looks surprisingly good.

The range of life of untreated lumber in this service averages from 4 to 7 years—so that the use of treated material saved from 1 to 3 trips to the shops. The savings are very worth while since the original installed cost was increased only slightly by the preservative treatment.

A lot of railroads that used to wonder if they could afford to use pressure-treated wood are now wondering if they can afford *not* to use it. If you would like to get a line on the general practice in specification for treatment, ask for our 2-page bulletin, "Pressure-treated Lumber for Railroad Cars," which digests this information in a convenient table.

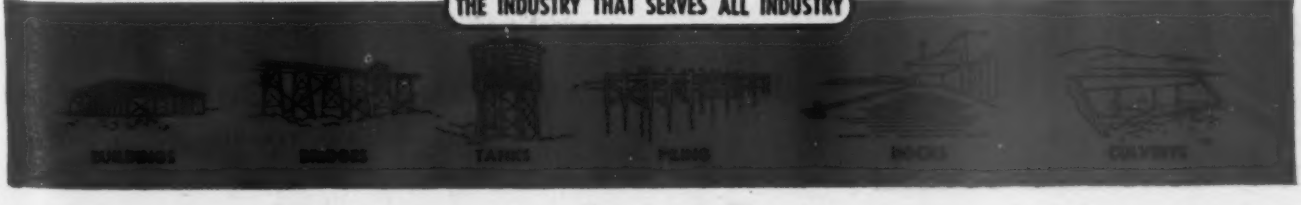
KOPPERS COMPANY, INC.—WOOD PRESERVING DIVISION

PITTSBURGH 19, PA.

KOPPERS

Buy War Bonds—
and Keep Them!

THE INDUSTRY THAT SERVES ALL INDUSTRY



JAL-TREAD

CHECKER FLOOR PLATE—STEPS UP SAFETY IN HANDLING TRAFFIC

Jal-Tread is J & L's new rolled steel floor plate with a real checker pattern that provides an efficient friction surface for floors, steps, vestibules, and all places where extra-safe footing is required.

Jal-Tread is weight-saving, yet tough and stands up under hard wear and abuse. It is pleasing in appearance and easy to clean. Its straight-line pattern affords speedy and efficient fabrication.

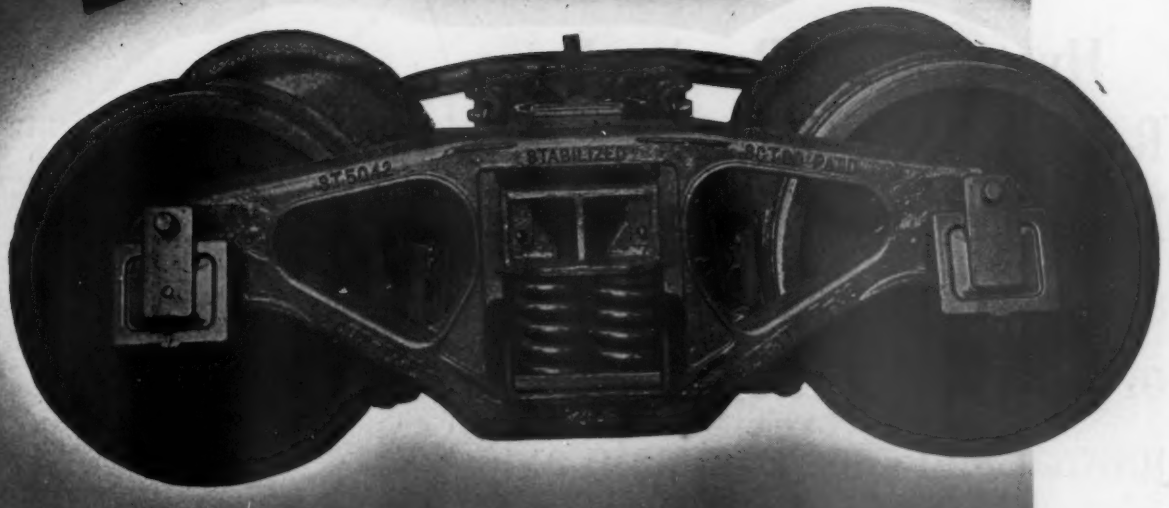
For delivery information, consult your nearest J & L office or regular supplier. Illustrated booklet gladly sent on request.

JONES & LAUGHLIN STEEL CORPORATION

PITTSBURGH 30, PENNSYLVANIA

CONTROLLED QUALITY STEEL FOR WAR AND PEACE

For Greater High-Speed Safety



Use Barber Stabilized Trucks

THEY PROTECT EQUIPMENT, LADING AND ROADBED

Barber Stabilized Trucks damp both the up and down movement of the spring supported bolster, the friction pressure being in proportion to the car load—IT IS NOT A FIXED PRESSURE.

A spring grouping with 2½" travel can be substituted for A.A.R. springs with only slight changes in the bolster and side frame.

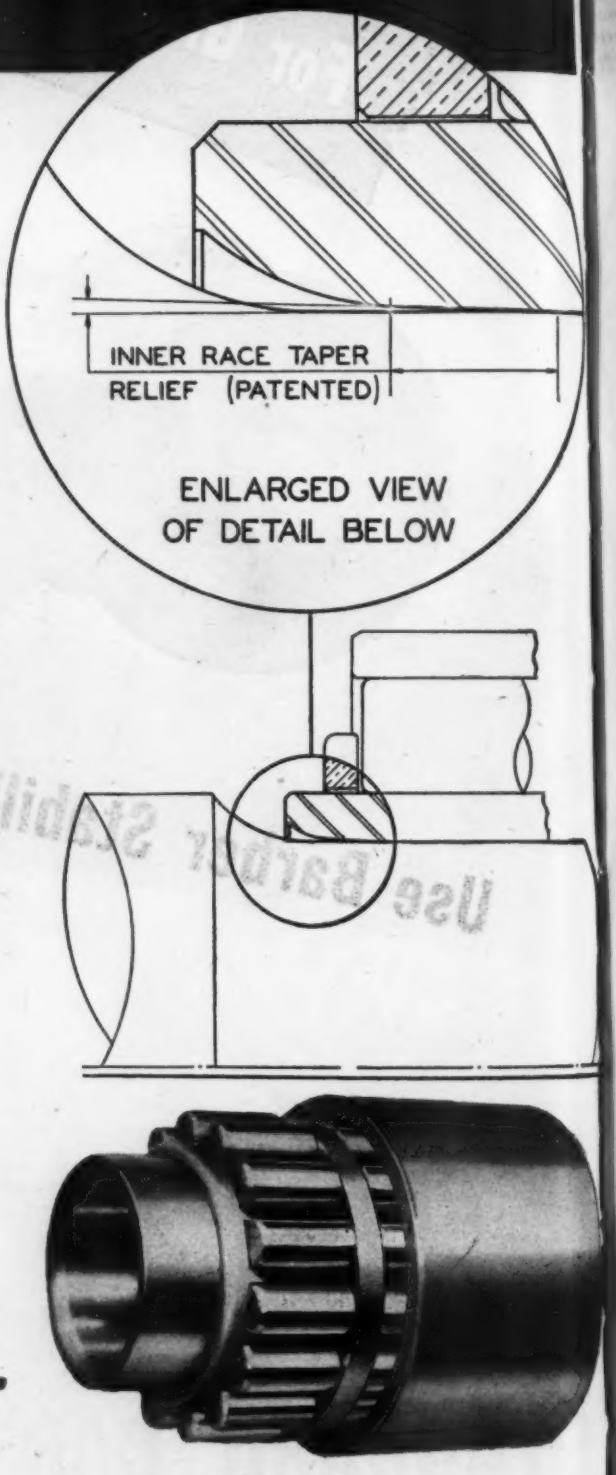
The effectiveness of Barber Stabilized Trucks is evidenced in the fact that they have now been selected for over 87,000 freight cars by 55 different railroads and private car lines.

STANDARD CAR TRUCK COMPANY

332 SOUTH MICHIGAN AVENUE — Chicago 4, Illinois

RELIEVE JOURNAL STRESSES

Hyatt Journal Bearing Inner Races with patented Taper Relief Fillet prevent localized stress concentration at the end of the inner race fit on the journal and thus eliminate axle breakage due to this cause.



Every railroad man will recognize the value of this feature. Hundreds of millions of miles on Hyatt equipped axles without journal failures have proved it.

In planning new equipment this Hyatt development is worthy of special consideration and emphasis.

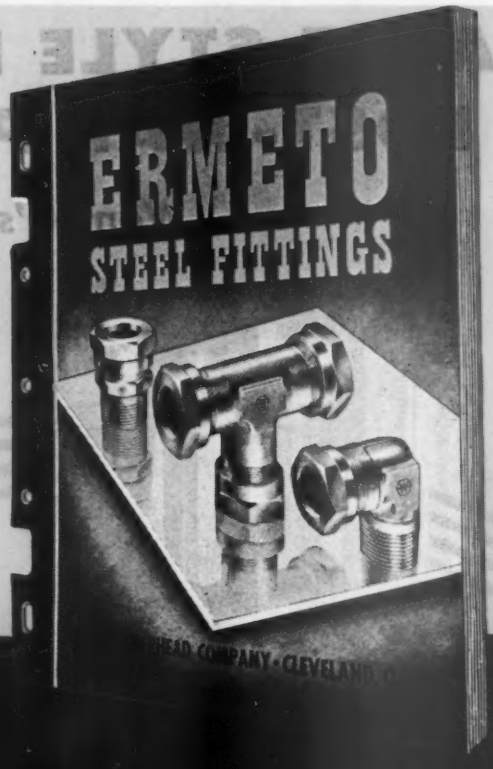
SPECIFY

BEARINGS HYATT

HYATT BEARINGS DIVISION • GENERAL MOTORS CORPORATION

HARRISON, NEW JERSEY • CHICAGO • DETROIT • PITTSBURGH • OAKLAND, CALIFORNIA

A must FOR YOUR CATALOG FILE



Every engineer, designer, service-man and industrial purchasing agent should have a copy of our newest Ermeto Fittings catalog, available for ready reference. This newest edition is the most complete to date and is yours for the asking. Write today or phone one of our branch offices.

Check these ERMETO features:

1. Easy and low cost installation. No flaring, welding, threading or soldering required!
2. Adaptable to all types of tubing connections—hydraulic, oil, water, gas and fuel lines!
3. Ermeto connections hold beyond the burst strength of the tube itself!
4. Ermeto joints withstand excessive vibration for an indefinite period!
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6. Unaffected by extreme degrees of heat or cold!

Look Ahead with

Weatherhead

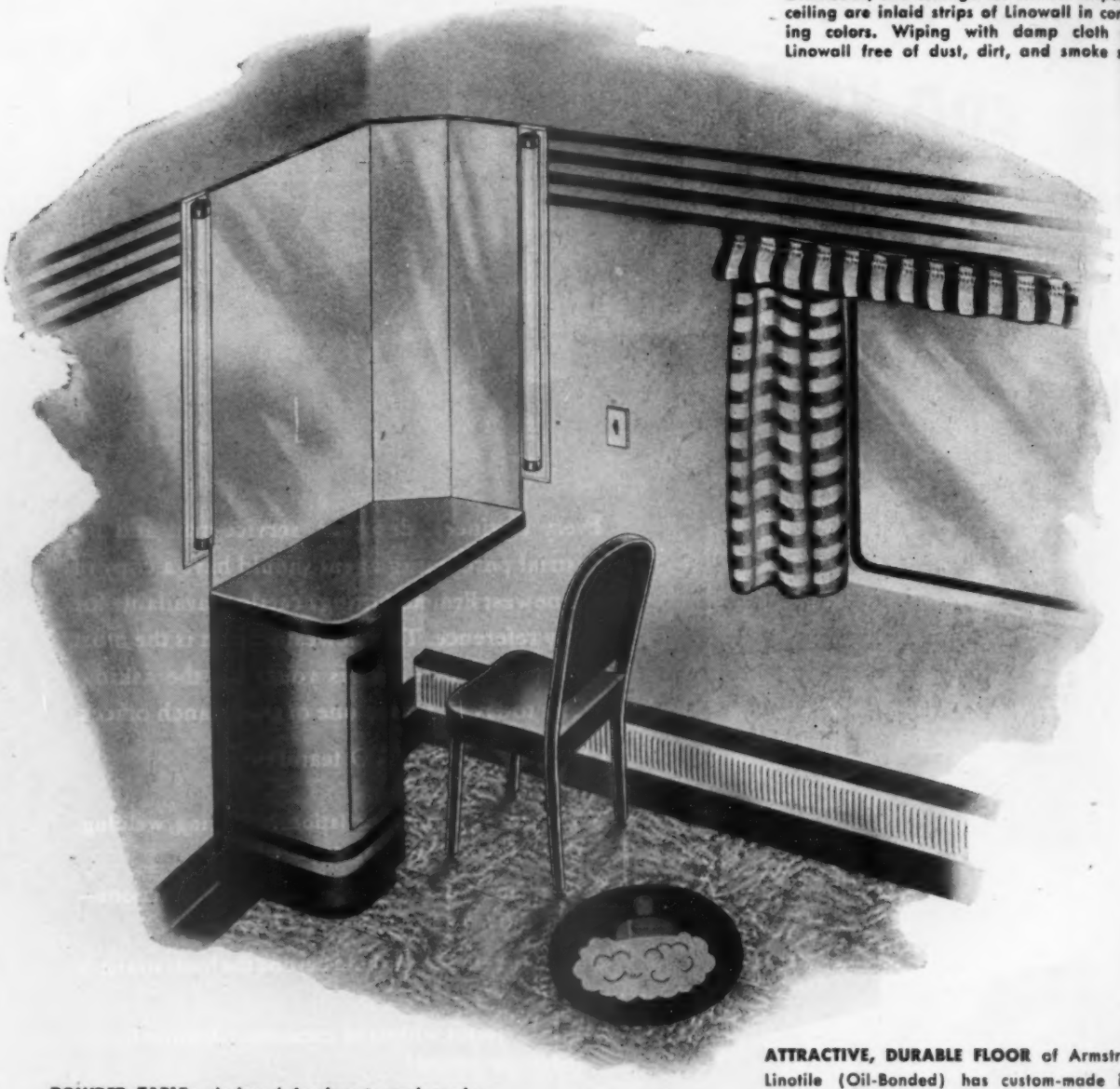
THE WEATHERHEAD COMPANY, CLEVELAND 8, OHIO

Branch Offices: New York, Philadelphia, Detroit, Chicago, St. Louis, Los Angeles

ADVANCE STYLE NOTES FOR POST-WAR PASSENGER CARS

Women's Lounge

COLORFUL, NON-SCUFFING SURFACES of Armstrong's Linowall provide smart sidewalls, bulkheads, and ceilings. Horizontal stripes near ceiling are inlaid strips of Linowall in contrasting colors. Wiping with damp cloth keeps Linowall free of dust, dirt, and smoke stains.



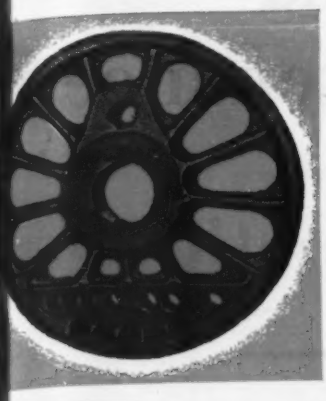
POWDER TABLE—designed for beauty and service—is surfaced on top and side with durable Armstrong's Linoleum. Colors contrast with wall. Waste basket is built into side of powder table; swings out on spring hinge—is easily removed for cleaning. (Tough, flexible Armstrong's Linoleum is easily formed around curves.)

ATTRACTIVE, DURABLE FLOOR of Armstrong's Linotile (Oil-Bonded) has custom-made inlaid design that adds extra eye-appeal. Ordinary sweeping and occasional washing keep Linotile looking bright for years. Armstrong's Cork Base underlayment saves weight, resists indentation. It can be used over any type of floor plate.

ARMSTRONG'S versatile floor and surfacing materials are the key to many striking effects—to durable smartness in every type of modern passenger car. For complete information and free samples of Armstrong's Linoleum, Linowall, and Linotile, write Armstrong Cork Company, Industrial Division, 7402 Arch Street, Lancaster, Pennsylvania.

ARMSTRONG'S
FLOORS and SURFACING MATERIALS
for passenger cars

THIS BABY BROKE UP THE CARS!

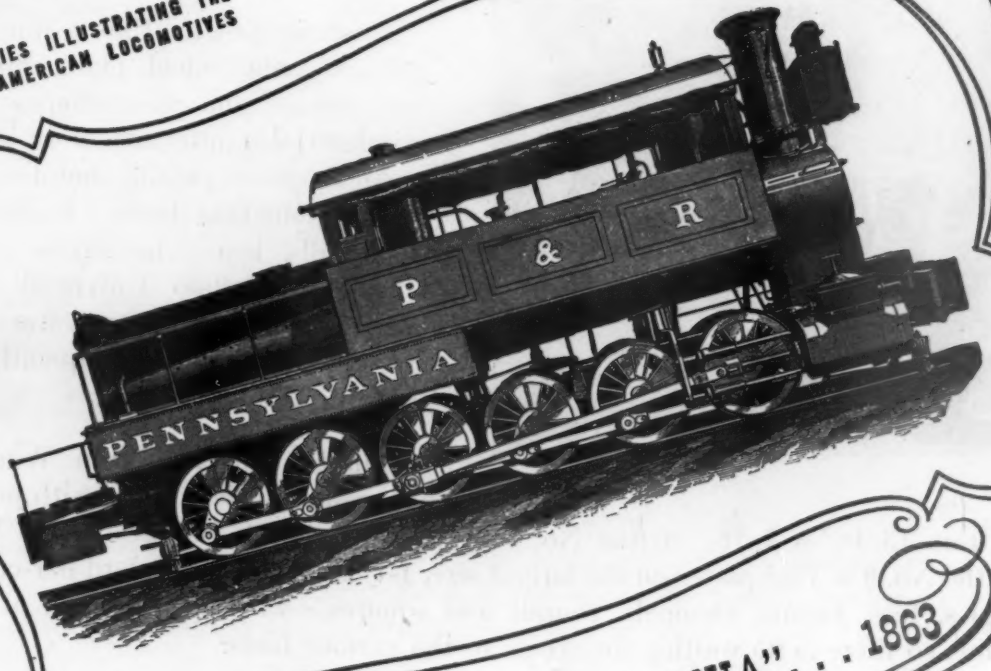


When James Milholland designed this first 0-12-0 pusher for the Philadelphia and Reading he put a lot of power on the rails—but it was power that lacked the smoothness imparted by...

Union WEB Spoke Driving Wheel Centers

- ★ Cruciform section spokes for great additional strength.
- ★ Reinforced rim support to eliminate flat spots, out of roundness, etc.
- ★ Correct distribution of metal for better balancing of smaller diameter wheels.
- ★ Wheels easily inspected before and after installation.
- ★ Troubles due to shrinkage eliminated by simplicity of design.
- ★ Can be made to any material specification.

OF A SERIES ILLUSTRATING THE
TION OF AMERICAN LOCOMOTIVES



THE "PENNSYLVANIA"... 1863

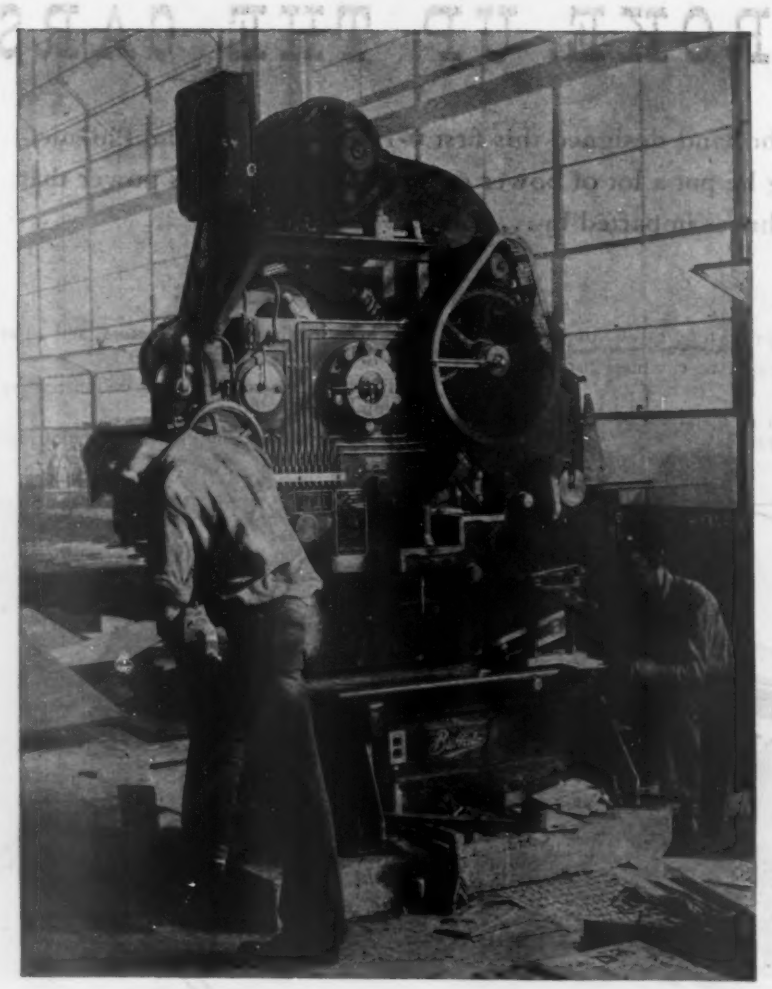
This novel locomotive was built to handle coal trains over the steep hills between the Schuylkill and Delaware Rivers. While originally both fuel and water were carried on the engine, it was later modified to a 10-wheeler with tender to better negotiate curves, some of which were as short as a 320 ft. radius. The "Pennsylvania" was so powerful that it proved destructive to the type of cars then used for handling coal.

From "IRON HORSES"... W. W. NORTON & CO., Inc.

ARMY E NAVY

UNION STEEL CASTINGS

DIVISION OF
BLAW-KNOX CO.
PITTSBURGH, PA.



Putting Maintenance on a Production Basis—

By shortening the time required to cut and punch steel plate, angles, tees, beams, and other shapes used in industrial maintenance work, many repair shops are putting maintenance on a production basis. Railroads, steel mills, heavy industries of all kinds use Buffalo Universal Iron Workers to speed up repair work, on new construction, and frequently on straight production work.

Buffalo Universal Iron Workers are made in fifteen sizes, with punch capacity ranging from 13/16″ x 7/16″ on the No. 0 to 1-3/4″ x 1-1/2″ on the No. 29 V.D. Shear capacity on the No. 0 is 3/8″ plates on the largest size, 1-1/2″ plates. Standard bar-cutter knives handle angles, tees, beams, channels, rounds and squares,—with special work at the machine at one time, so there is no waiting for access to the various tools.

Thousands of Buffalo Universal Iron Workers are now serving industry — providing quick economical cutting and punching facilities. Operated by unskilled labor, Universal Iron Workers turn out good work with a minimum of supervision. Your shop, if it handles plate and structural work, can use a Buffalo Universal Iron Worker to advantage. Why not get details and prices now?

This Bulletin

shows full details of construction, extra equipment available, and complete capacity tables and specifications for all models.

WRITE FOR IT

Buffalo Forge Company

174 Mortimer Street, Buffalo, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

"Buffalo" Universal Iron Workers

32 VOLTS, 64 VOLTS, or 110 VOLTS?

The modern lightweight streamlined car makes extensive use of electric power; the same will undoubtedly be true of the post-war car.

Will the post-war passenger cars have 32-volt, 64-volt, or 110-volt electrical systems? Whatever the choice, Edison Alkaline Batteries will provide standby power of highest dependability; 25-cell, 50-cell, and 88-cell batteries have been in successful use with all three systems for a number of years.

After a battery has delivered its normal service life on a 64-volt or 110-volt car, it can be regrouped into 25-cell batteries and these batteries applied to 32-volt baggage and express cars having loads for which their capacity is still adequate, thus giving additional years of dependable service.

A number of railroads get this "second life" from their Edison Alkaline Batteries. They could hardly afford to do it if they did not know that an alkaline battery remains a dependable power even after its normal service life has been completed. It's a feature of alkaline batteries that designers of post-war cars are invited to look into. *Edison Storage Battery Division of Thomas A. Edison, Inc., West Orange, New Jersey.*

An alkaline battery in the battery compartment saves weight where it counts the most. It is suspended near the middle of the car where every pound saved may be as effective in reducing structural stresses as five pounds saved elsewhere. The larger the kilowatt-hour capacity, the greater is the weight that can be saved by the use of an alkaline battery.

Edison

THE LIGHTWEIGHT BATTERY
FOR LIGHTWEIGHT CARS

"Our windows at home aren't this clear, Mother!"

It's easy to see why. The "breather" feature of Adlake Double-Glazed Windows permits air between the two panes of glass to adjust itself quickly to changes in temperature, altitude, humidity. The two panes, hermetically sealed, assure visibility at all times unaffected by fog or frost.

The only maintenance required is routine washing and replacement of panes broken in service . . . there is no dehydrating compound, no devices at all to service.

Adlake Double-Glazed Windows are again furnished in aluminum and can be aluminated if desired. They are designed and produced for new cars or reconditioning present equipment, and to standards that have won their reputation for superiority throughout years of service. Write for prices and details . . . and specify Adlake.

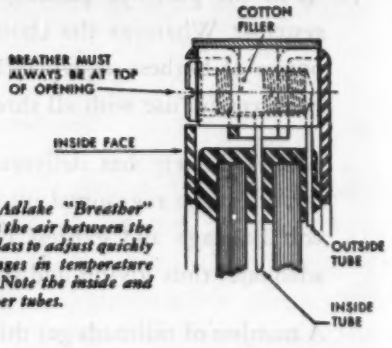
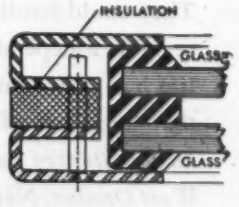


Diagram of Adlake "Breather" which permits the air between the two panes of glass to adjust quickly to rapid changes in temperature and altitude. Note the inside and outside breather tubes.



Both frames of the Adlake sash are insulated from each other. This prevents cold from traveling to the inside face of the unit and eliminates frosting.

Adlake TRADE MARK

The Adams & Westlake Company

ESTABLISHED IN 1857 — ELKHART, INDIANA — NEW YORK · CHICAGO

ADLAKE RAILWAY CAR EQUIPMENT, FITTINGS and SPECIALTIES • DOUBLE-GLAZED ALUMINUM WINDOWS • WINDOW CURTAINS • VESTIBULE CURTAINS • SECTIONAL DIAPHRAGMS • LUGGAGE RACKS • ASH RECEPTACLES • HARDWARE

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No Other Material Can Equal ALLOY STEELS

Hardenability—one of the most important qualities of steel—reaches the ultimate in alloy steels. No other material can be softened for working and hardened to resist wear to the high degree attained in alloy steels.

With alloy steels, you can increase depth of hardening. You can harden with greater ease and assurance of uniform results. You can definitely help insure against non-hardened areas or soft spots in wearing surfaces.

And in heat after heat of alloy steels, the physical attributes are repeated faithfully time after time—providing a margin of properties found in no other material. In other words, uniformity of physical properties is greatest in alloy steels.

When you have a problem involving hardenability—or high strength to weight ratio; resistance to wear, strain, shock, fatigue, heat, cold or corrosion; or any other specification, consult Republic metallurgists. Their unequalled experience in the production and fabrication of alloy steels is yours to help you achieve greater safety and economy in severe service.

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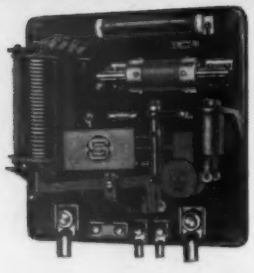
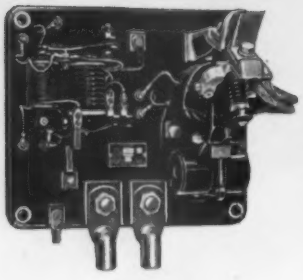
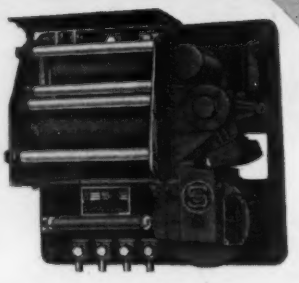
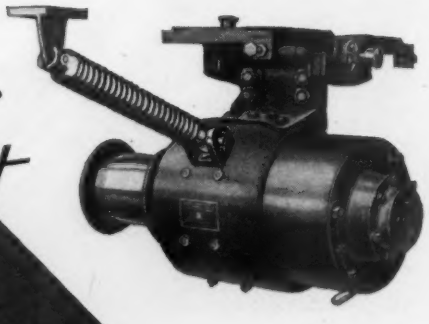
Republic
ALLOY STEELS

Also Sheets—Plates—Pipe—Upson Bolts, Nuts and Rivets—Electrunite Boiler Tubes

LIGHTING AND AIR CONDITIONING EQUIPMENT FOR RAILWAY SERVICE



For Passenger Comfort

SAFETY Axle Generator System . . . SAFETY Air Conditioning System . . . SAFETY correctly designed and appropriately styled lighting fixtures . . . Railroads, from years of experience, know that the installation of SAFETY Company Equipment backed by SAFETY Engineering service, offers a sure means toward perfecting a satisfying uninterrupted passenger service with reasonable installation expense and low maintenance cost.

ARMY (E) NAVY

THE SAFETY CAR HEATING AND LIGHTING COMPANY, INC.

NEW YORK • CHICAGO • PHILADELPHIA • BOSTON
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1. Palletized Loads
2. Electric Trucks
3. Exide Batteries

The time-and-cost cutting trio

"Car loading time cut from 20 man-hours to 1½ hours" . . . "unloading costs cut from $1.37 to $0.113 per ton" . . . "128 man-hours per day saved in unloading and storing!" Such are the time-and-cost cutting reports that tell of the economies resulting from palletization and battery-powered electric Industrial trucks.

Exide Batteries are in use throughout the country, powering thousands of the electric trucks engaged in handling materials by this modern method. Exides have ample reserves to meet every power need, and to keep trucks moving at sustained speeds throughout the day. You can always count on Exides for dependability, long-life and ease of maintenance.

Write us for a FREE copy of the bulletin "Unit Loads," prepared by The Electric Industrial Truck Association. It tells how to cut handling costs up to 50% . . . covers latest developments in materials handling . . . and includes actual case histories.

ARMY E NAVY

Exide
BATTERIES

THE ELECTRIC STORAGE BATTERY CO., Philadelphia 32

Exide Batteries of Canada, Limited, Toronto

CONGRATULATIONS...

ON BOTH YOUR FINE WORK AND FORESIGHT ON THE PAYROLL SAVINGS PLAN!

IN your wholehearted support of the Payroll Savings Plan, you are doing far more than backing the most valid system of war financing—and building a powerful dam against the onrush of dangerous inflationary dollars.

By encouraging the all-out participation of your employees in this greatest of all savings plans, you are helping to create a sound economy for post war days.

With this same plan, you are assisting working America to build a mainstay against the inroads of unemployment and want—to save for homes, educational advantages and old age comforts!

You and your employees, through *mutual* cooperation in this forward-looking plan, are gaining a new and closer understanding—the cornerstone of a firmer, *mutually* profitable relationship!

National benefits, too, follow the "All Out" effort you are making! The prosperity of our United States rests on the economic stability of both management and labor. Your Payroll Savings Plan is working constructively toward the assurance of both!

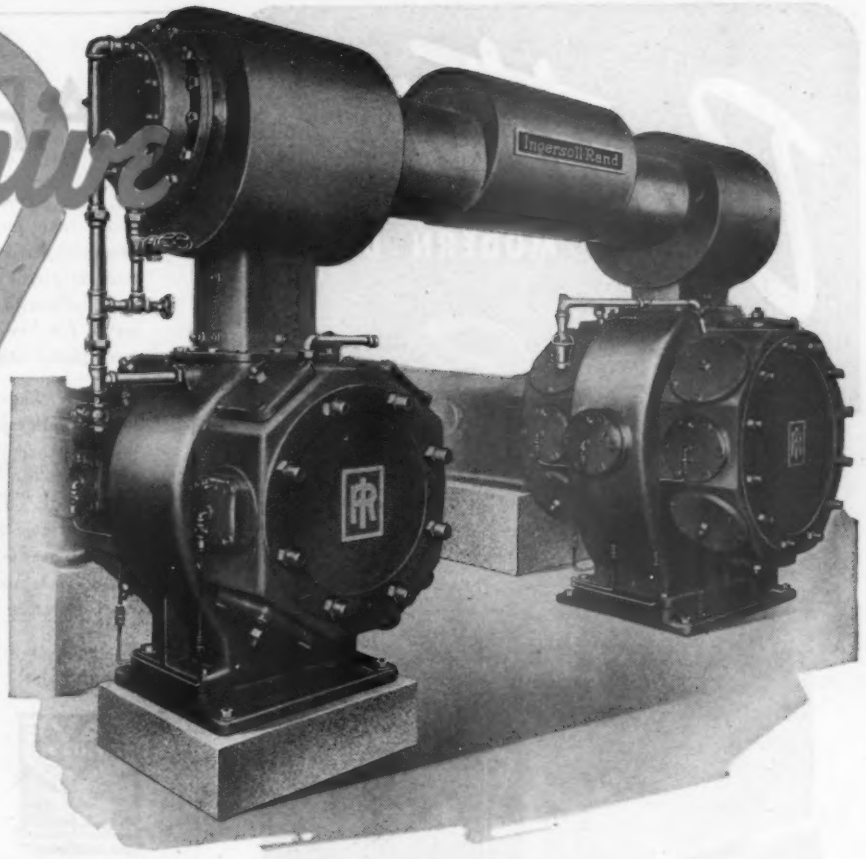
The Treasury Department acknowledges with appreciation the publication of this message by

RAILWAY MECHANICAL ENGINEER

This is an official U. S. Treasury advertisement prepared under the auspices of Treasury Department and War Advertising Council

Which drive?

- ELECTRIC
- STEAM
- OIL
- GAS
- BELT



THERE'S ALWAYS ONE BEST DRIVE FOR YOUR COMPRESSOR

Perhaps it's a direct-connected electric-motor which best fits in your over-all power layout . . . a synchronous motor improves the power factor.

Or it may be steam, especially when the exhaust can be profitably used in process work or heating.

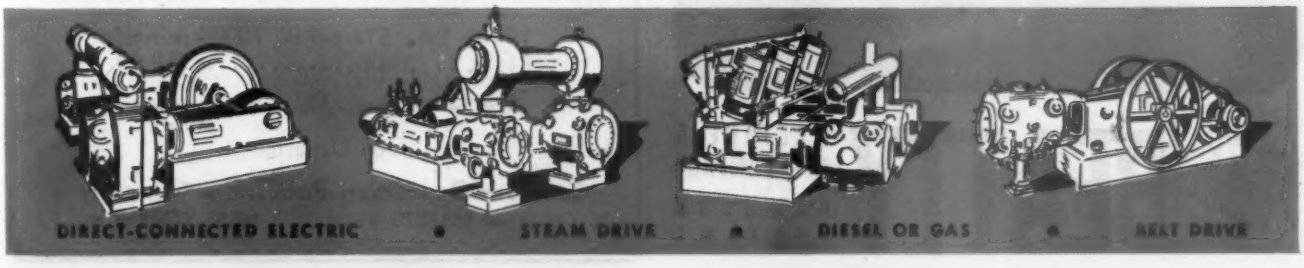
Then there are conditions best met by direct-connected oil- or gas-engine drive. In other cases, belt drive may be the correct solution.

But there is always *one best* choice, and there is no need to guess the answer. Ingersoll-Rand can furnish you compressors with any type of drive, and I-R engineers will be glad to study the problem with you, helping you select the compressor which best suits *your* conditions.

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

I-442



Beatty

MODERN DESIGN

• The modern contour of this new BEATTY Heavy Metal Working Press reflects its equally advanced engineering. The finer performance of BEATTY equipment is proof that two heads are better than one, for every BEATTY machine combines the thoughts of a BEATTY engineer and a fabricator with a problem. Each machine is custom-built for the job to be done. And here's an invitation: Bring your next heavy metal working problem to us; perhaps we have solved many similar problems.

HYDRAULIC HEAVY METAL WORKING EQUIPMENT

BEATTY MACHINE & MFG. COMPANY HAMMOND INDIANA

PAPER HELPS FINISH THE JOB

Don't take paper for granted. Waste paper used to be as common as air or grass. Today it must be conserved as a raw material for the manufacture of new paper and paperboard.

Your wastebasket scraps can help supply the needed wrapping and packaging materials—*if you make sure they are collected.*

Paper packages, medical and food supplies for liberated peoples, for armies of occupation and for the fighting forces everywhere. Every article going overseas . . . each tiny surgical needle and instrument part . . . every tank or plane . . . is made, wrapped or tagged with paper. Your waste paper is a basic raw material for that war paper.

Wastebasket scraps, brown corrugated cartons, brown wrappings or bags, old newspapers and magazines . . . all should be saved, collected and put to work again.

U. S. Victory Waste Paper Campaign

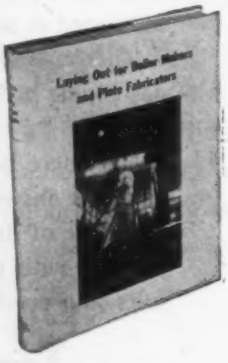
NEW FIFTH EDITION

LAYING OUT FOR BOILER MAKERS AND PLATE FABRICATORS

REVISED BY

GEORGE M. DAVIES

Boiler Designer, New York Central



Completely revised and with new chapters on Locomotive Boiler Construction, Laying Out and Computing Boiler Patches, and Laying Out for Welded Construction, this well-known book is again in print. Set in larger type and with more than 700 new clear scale drawings of all kinds of sheet metal and boiler plate layout problems.

Information is presented in plain shop language and without resort to higher mathematics. A complete index enables the book to be used for ready reference.

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INSULATION

WATER NEVER HURTS IT!

Washing of cars is harmless to the insulation if it's HAIRINSUL . . . because water never hurts it!

Refrigerator car insulation often gets wet from melting ice or washing, but don't worry if your cars are lined with HAIRINSUL... the superior HAIR FELT insulation that dries out good-as-new... never rots, never deteriorates, always keeps its original *ice-saving* efficiency.

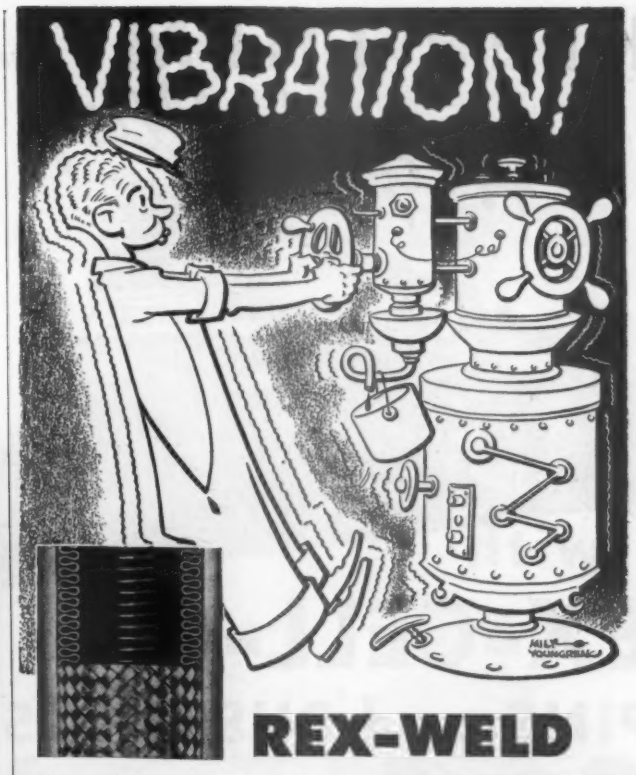
In every way, HAIRINSUL is a permanent investment. It never separates, pulverizes or develops ice-wasting gaps that need repacking . . . it's all-hair in reinforced blanket form . . . flexible and easy to install in new or rebuilt cars, and economical to use time and again as older cars wear out. Write today for samples and engineering data.

Hair Is Nature's Own Insulation
It's nature's protective covering for animal life . . . it's a barrier against extreme outside temperature changes. HAIRINSUL is made of animal hair . . . one of the best reasons why HAIRINSUL is accepted as the finest of insulating materials for refrigerator cars.

AMERICAN HAIR & FELT COMPANY
Dept. D-2, Merchandise Mart, Chicago 54

Hairinsul

ALL HAIR INSULATION FOR REFRIGERATOR CARS



REX-WELD

flexible metal hose CONTROLS IT

Chicago Metal Hose Corp.'s REX-WELD is highly resistant to fatigue even when subjected to constant vibration over long periods of time. It is extremely flexible and remains airtight and leakproof after years of hard usage. It stands up under high temperature and prolonged flexing. REX-WELD is fabricated from strip metal and is precision autogenous welded to form a weld stronger than the tube itself. Write, giving complete information and we will be glad to furnish engineering recommendations for any design problem.

Our engineers will recommend the type of flexible tubing most adaptable to these uses—

1. For conducting liquids from a vibrating to a stationary medium.
2. For high fatigue resistance under constant vibration.
3. For handling searching liquids without seepage.
4. For extreme temperature conditions.
5. For use where corrosion resistance is a factor.
6. For conducting liquids and gases to reciprocating parts.
7. For maximum flexibility with a minimum of length.
8. For dampening noise between two units that must have pipe connections.
9. For correcting misalignment.

ARMY E NAVY Flexible Metal Hose for Every Industrial Use

CHICAGO METAL HOSE CORPORATION
MAYWOOD, ILLINOIS

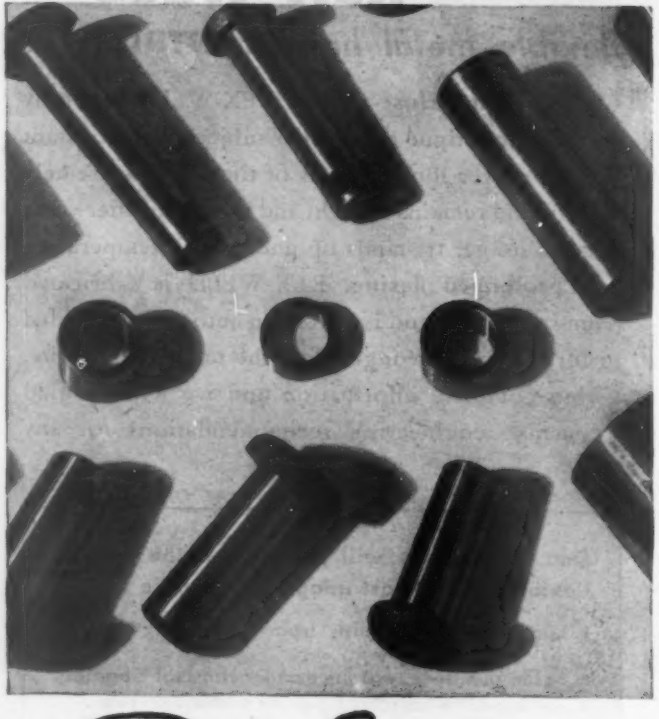
Plants: Maywood and Elgin, Ill.

KEEP THEM "Highballing"

with

EX-CELL-O

PINS and BUSHINGS



XLO

EX-CELL-O for PRECISION

Railroad Division

EX-CELL-O CORPORATION

Detroit 6, Michigan

BECAUSE they are precision-made, Ex-Cell-O railroad pins and bushings reduce wear on other parts and give longer trouble-free service. The result—less "out of service" time; fewer repairs for essential equipment. More than 125 American railroads have standardized on Ex-Cell-O pins and bushings. Ex-Cell-O catalog 32301 shows styles and sizes. Write for your copy today.

EX-CELL-O PINS AND BUSHINGS

ONE LEVER—

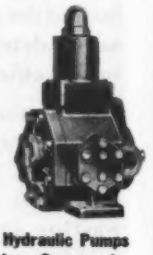
provides complete control

Single lever hydraulic control of RACINE's Heavy Duty Metal Cutting Saws marks a new era in the efficiency of metal cutting machines. Gone are cams, weights, ratchets, levers and other outmoded methods of applying feed, lift and other operating functions.

RACINE Machines, under full hydraulic operation and control, are simple in design—rugged in construction—easy to handle—and accurate to the last degree.

The RACINE Machine you buy today represents over thirty-six years experience in metal cutting. Thirty-six years of constant research, development and improvement.

Out of RACINE's complete line, in capacities from 6" x 6" to 20" x 20", some one machine will handle your work to the best advantage. Write for our complete Catalog No. 12. Also outline your metal cutting operations. Our engineers will supply definite recommendations without cost to you. Address Racine Tool & Machine Co., 1740 State St., Racine, Wisconsin.



comparison proves

- ★ Design based on machine tool standards—incorporates modern hydraulic principles.
- ★ Progressive feed — each tooth removes a long curled chip.
- ★ Ease of operation—insures capacity production in every shop.
- ★ Simple, rugged construction—trouble free operation—these machines stay at work.

Racine Oil Hydraulic Pumps .. A Modern Source of Hydraulic Force

The flexibility of your hydraulic circuits can be increased with RACINE "Variable Volume" Pumps. Three sizes: 12, 20 and 30 G.P.M. Pressures 50 to 1000 lbs. P.S.I. Ask for Catalog No. P-10-C. Give us a summary of your hydraulic problems.

RACINE

RACINE

ROUSTABOUT CRANE

Speeds a hundred handling jobs around your plant . . .

Roustabout saves you time and money on these and many other jobs

- **Big stuff off and on trucks, freight cars**
- **Moving large machines**
- **Handling bales, boxes, drums**
- **Moving big castings, motors, railroad and marine gears**
- **Loading air transport planes**
- **Handling tanks, pipe, structural steel**
- **Installing heavy valves and fittings**

● There's always something heavy to be moved, loaded, unloaded, stacked — regular and emergency jobs. You do such jobs quickly, without special crews taken from other work, at low cost, with a Roustabout Crane. Always ready where and when you want it, powerful, versatile—loads to 7½ tons, ball-bearing boom turntable, gears in oil — built for years of overwork. . . . Write at once for the story of this handy fast-action load-handler, which hundreds of plants regard as indispensable.

THE HUGHES-KEENAN COMPANY
605 NEWMAN STREET • MANSFIELD, OHIO

Roustabout Cranes
By Hughes-Keenan
Load-Handling Specialists Since 1904

EDNA
(Reg. U. S. Pat. Off.)

UNIVERSAL LUBRICATING SYSTEM

AUTOMATIC AUXILIARY LUBRICATOR

PROVED BY YEARS of Trouble-Free Service

. . ON AIR PUMPS
. . STOKER ENGINES
. . FEED WATER PUMPS

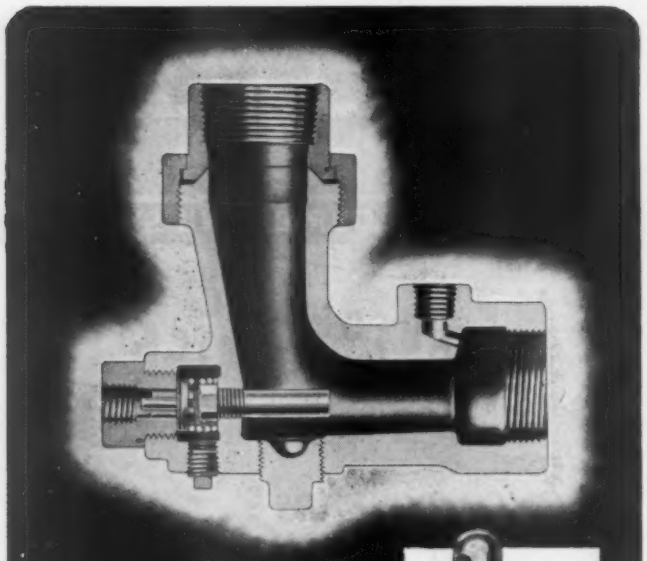
The Edna Automatic Auxiliary Lubricator provides positive lubrication for a locomotive whether running or standing. Extremely simple in construction, the Edna Lubricator has only two wearing parts — proved by years of service to be trouble-free. Extremely low in initial cost, this device requires minimum attention and maintenance, consumes oil without waste. Used by leading railroads. Write for Bulletin A-100B giving complete details.

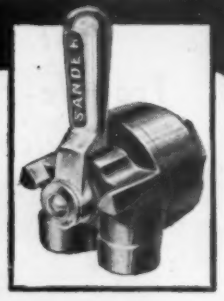
FORCE FEED LUBRICATORS
"POSITIVE" OIL FEED DIVIDERS
AUTOMATIC AUXILIARY LUBRICATORS
HYDROSTATIC LUBRICATORS • OIL CUPS
LIFTING and NON-LIFTING INJECTORS • BOILER CHECKS
VALVES • COCKS: CYLINDER — GAUGE — TANK
REFLEX WATER GAUGES • WATER COLUMNS
"EDNALOY" CASTINGS

THE EDNA BRASS MFG. CO.

Sales Agent of National Lead Company

525 READING ROAD CINCINNATI 2, OHIO





Viloco SANDERS

For Diesel and Electric Locomotives

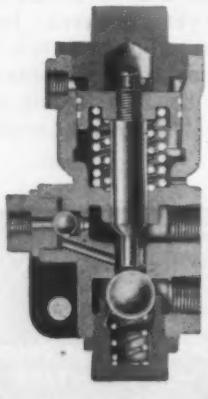
The Viloco Sander equipment for Diesel and Electric Locomotives is especially designed for this type of service. It is economical in the use of sand and air; reliable and efficient under all weather conditions.

Viloco Sander Trap Type GB-342

The Type GB-342 is made with a horizontal discharge as illustrated above, and is provided with a clean-out nozzle. The sander nozzle which controls delivery of sand is fixed and cannot be altered promiscuously. Any alteration in delivery requirements is simplified by applying a longer or shorter nozzle. A check valve with composition gasket prevents back pressure from blowing sand into the air line. If the installation requires angle discharge the Type GA-343 trap should be specified.

Viloco Sander Valve No. 350

The Operating Valve is compact and simple in construction. Its small size permits location within easy reach of the engine men. This valve is connected to operating cylinder of Relay Valves.



Viloco Relay Valve No. 341

The Viloco No. 341 Relay Valve is constructed to provide a clean-out blast, of a predetermined interval, before and after each sanding operation. A more efficient clean-out is obtained through the use of a ball check arrangement. This new feature prevents delivery of sand while clean-out air is flowing, thus overcoming excessive cutting of traps and piping, and at the same time conserving the sand supply.

VILOCO RAILWAY EQUIPMENT CO.

332 SOUTH MICHIGAN AVENUE · CHICAGO

Fast, easy pipe cuts with this 4-wheel RIDGID

Regular **RIDGID** *Cutter has fast cutting thin-blade wheels.*

Cuts cleanly with a quarter turn

● In tight places it's a wonder. Short handle — and 4-wheels mean swift clean easy cuts, which you'll enjoy also where there's plenty of room to work. A beautifully balanced husky cutter that doesn't fool around, the stout frame making the special heat-treated steel wheels always cut true. Two sizes: No. 42, ½" to 2"; No. 44, 2½" to 4". Buy it for better cutting and long service — at your Supply House.

RIDGID

WORK-SAVER PIPE TOOLS

THE RIDGE TOOL COMPANY · ELYRIA, OHIO, U. S. A.

MILWAUKEE Portable Locomotive Crank Pin Grinder

CRANK PINS RECONDITIONED WITH SPEED AND ACCURACY

There is no need to drop wheels, remove guides or other parts when using this machine. Your locomotive will be back in service in 12 hours with all pins correctly ground.

Save Time, Labor, Material and Equipment with the MILWAUKEE Crank Pin Grinder.

The saving in brass alone will repay the original cost of the machine in a reasonable length of time.

IT'S PORTABLE . . . IT'S FAST
IT'S SAFE

JOSEPH SINKLER, INC.

122 S. Michigan Avenue — Chicago 3, Ill.

IDEAL TUBE EXPANDERS

IDEAL RAILROAD ARCH

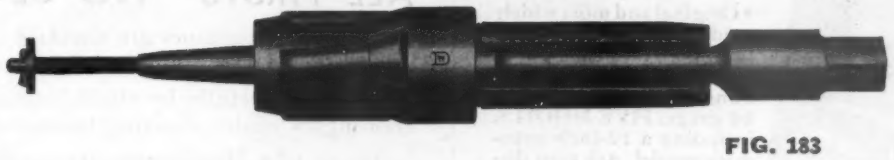


FIG. 183

THE LEADING TUBE EXPANDERS FOR THE PAST 52 YEARS IN AMERICA'S LEADING RAILROAD SHOPS

Ask for Catalog No. 57R

THE GUSTAV WIEDEKE COMPANY

DAYTON — OHIO

FROM LOCOMOTIVE SHOP
TO POWER TOOL CAR . . .

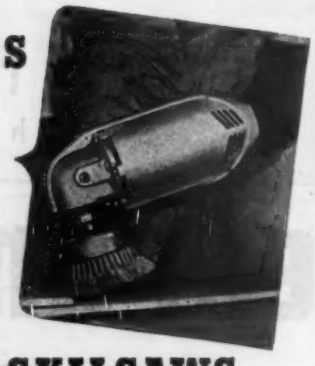
SKILSAW TOOLS
Get More Done with Fewer Men!

SKILSAW
DRILLS

• Faster working because they're more powerful, lighter in weight, easier to handle. ELEVEN MODELS, with capacities of ¼ inch to ¾ inch in steel, ½ to 2 inches in wood. Ask your distributor for a demonstration on your work.

SKILSAW
DISC SANDERS

• Fastest portable electric tools for grinding down weld beads and fins, for sanding any curved surface, or removing rust or scale. THREE MODELS, all with special protection for brushes and commutators. Ask your distributor for a demonstration.



SKILSAWS

• Original and most widely used portable electric saws. Cut faster on all wood up to 4⅜ inches, on compositions, and on metals up to 16 gauge. FIVE MODELS, including a 12-inch pneumatic model. Ask your distributor for a demonstration on your own work.

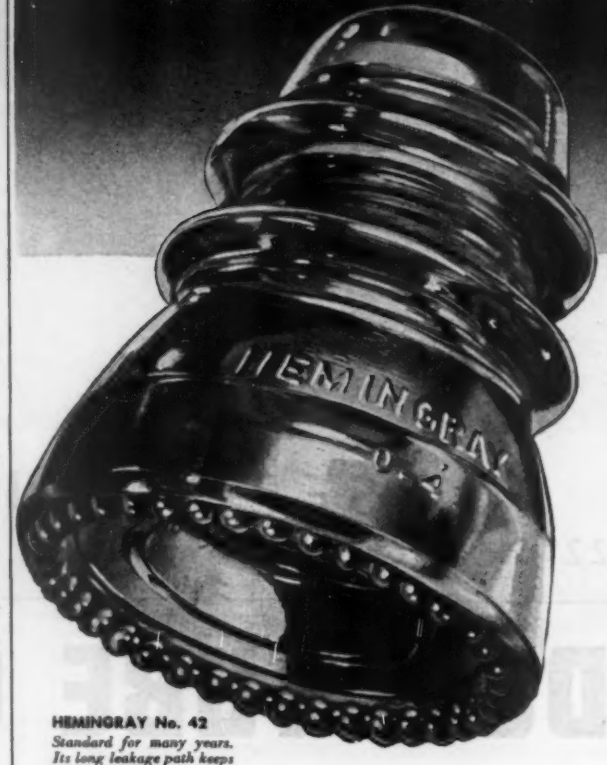
SKILSAW
BELT SANDERS

• Speed up all sanding on flat surfaces of any material. FOUR MODELS, up to 4½ inch belt width. Ask your distributor for a demonstration today.

SKILSAW, INC.
5033-43 Elston Ave., Chicago 30, Ill.
Sales and Service Branches in All Principal Cities

SKILSAW PORTABLE ELECTRIC TOOLS
MAKE AMERICA'S HANDS MORE PRODUCTIVE

HEMINGRAY INSULATORS
Favorably Known Since 1870



HEMINGRAY No. 42
Standard for many years. Its long leakage path keeps toll lines trouble-free.

ALL FIRSTS—NO SECONDS!

Hemingray Insulators are checked and rechecked—all along the production line.

Checked carefully by visual inspection—checked thoroughly under exacting laboratory control!

That's why Hemingrays are so uniform, so dependable. That's why Hemingrays cost so little in actual service life.

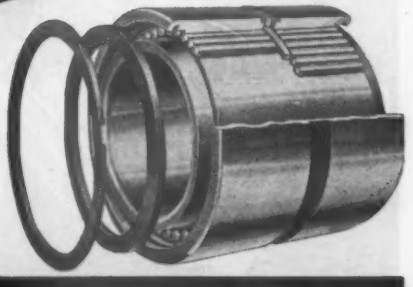
Hemingrays are sold by principal jobbers and are manufactured by Owens-Illinois, Hemingray Division, Muncie, Indiana.

OWENS-ILLINOIS
HEMINGRAY INSULATORS
Telephone-Telegraph

Export Agents: International Standard Electric Corporation, New York City

5 Points of Superiority in Baker Valve Gears

The new Baker Valve Gear has five points where McGILL *MULTI-ROL* Bearings may be applied. Thus great savings in maintenance plus large increases in mileage are effected. Baker Valve Gears and McGILL *MULTIROL* Bearings make a record-breaking team. 500,000 miles and more without attention is not unusual.



Special Bearings can be made to suit any unusual condition and to answer any specific problem. Write the McGILL Manufacturing Company, Inc., Valparaiso, Indiana for information.

THE PILLIOD COMPANY 30 Church St., New York, N.Y.—310 S. Michigan Ave., Chicago, Ill.
Factory—Swanton, Ohio

Journal Box Lids

by Motor Wheel

- Pressed steel lid.
- No tools required for application to journal boxes.
- Articulated assembly.
- Completely enclosed coil.
- Complete access to box provided by 115 deg. opening.
- Furnished for 5 x 9, 5½ x 10 and 6 x 11 boxes.

Motor Wheel Lids Meet All A. A. R. Requirements

NATIONAL RAILWAY SALES REPRESENTATIVES

T-Z RAILWAY EQUIPMENT CO., INC., Chicago, Ill.

MOTOR WHEEL CORPORATION LANSING, MICHIGAN

SERVICE VALVES BETTER... FASTER AND LESS OFTEN
Greater loads, more continuous hours of operation and shortage of service help are putting a terrific load on diesel valves. With the HALL Model EDP Valve Seat Grinder and Model 80A Wet Type Valve Relacer shown here, diesel valves can be serviced with original factory precision, finish and speed. That's why valves serviced with HALL equipment perform better . . . longer; why engines need be out of service for shorter periods and less often. Write for information
THE HALL MANUFACTURING CO.
TOLEDO 7, OHIO
HALL
FOR VICTORY BUY UNITED STATES SAVINGS BONDS STAMPS

SHELDON

PRECISION LATHES

Among moderate priced lathes, the SHELDON 1026 BMWQ is not only superior in design, workmanship, features and precision, but in its convenient, space-saving and *more efficient* overhead motor drive. . . .

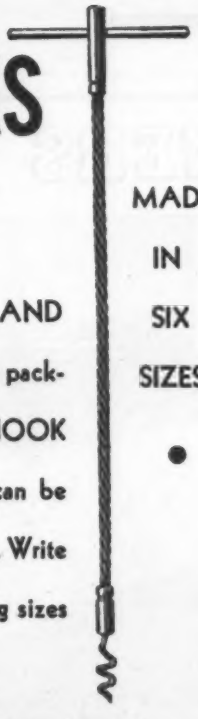
Write for Catalog

SHELDON MACHINE CO., INC., 4216 N. KNOX AVE., CHICAGO 41, U.S.A.

Remove Packings this EASIER way

Use DURA HOOKS

Sturdy ALL STEEL Packing Pullers



MADE IN SIX SIZES

YES, HERE IS A TIME AND labor saving device for removing old packings from stuffing boxes. DURA HOOK is a tough flexible hand tool that can be used in those "hard-to-get-at" places. Write today for illustrated bulletin covering sizes and prices.

Manufactured by The Originators of Twisted Foil Metallic Packing

DURAMETALLIC CORPORATION
The PERFECT SEAL
KALAMAZOO MICHIGAN

CHICAGO • DALLAS • DETROIT • FREDERICKSBURG, VA. • HOUSTON
KANSAS CITY, MO. • LOS ANGELES • MONTREAL • NEWARK • NEW ORLEANS • PITTSBURGH • ST. LOUIS • SAN FRANCISCO • SEATTLE
TULSA • YOUNGSTOWN, OHIO

ADECO NOZZLE TESTER

★

FOR DIESEL ENGINES

KEEP DIESEL ENGINES RUNNING AT PEAK EFFICIENCY

With this sturdy, portable, light-weight Adeco Nozzle Tester, any mechanic can easily make quick, accurate tests on injector opening pressure, spray pattern, etc., and detect stuck needle valves and leakage around valve seats. Adeco advantages have made this America's most widely used nozzle tester. Tests both large and small injectors, on bench or engine. Avoids costly delays and possible damage to engine. Keeps diesels operating at peak efficiency.

Write for new illustrated bulletin.

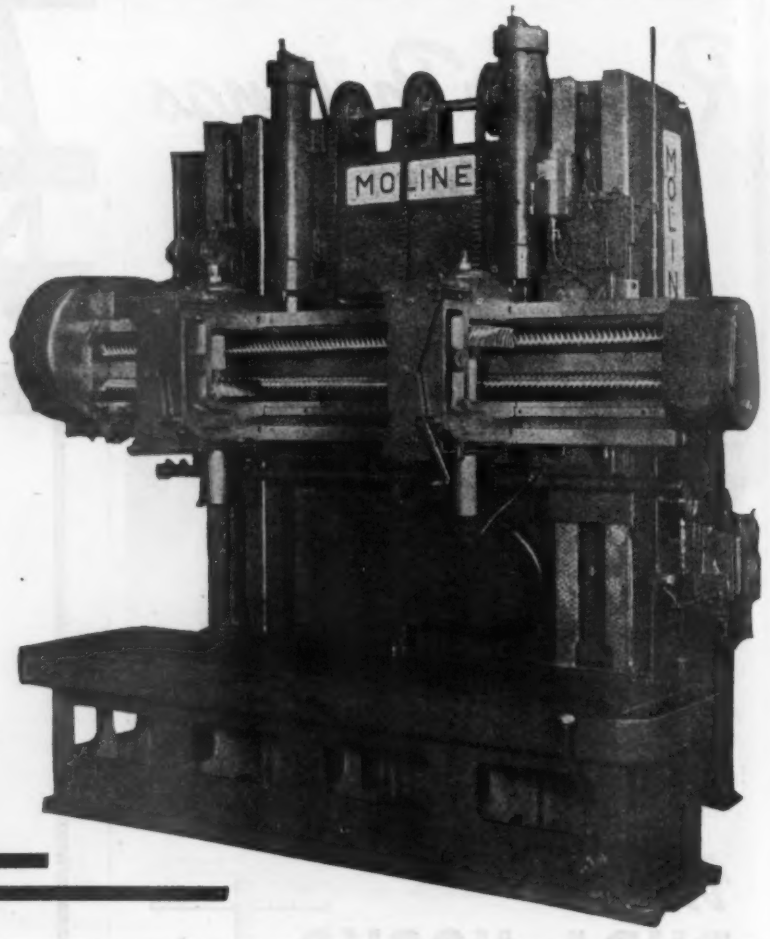
ADECO
AIRCRAFT & DIESEL EQUIPMENT CORPORATION
4411 NORTH RAVENSWOOD AVENUE
CHICAGO 40, ILLINOIS

"Hole Hog" or Nothing

Farm implement makers, railroad shops, as well as manufacturers of road machinery and oil well equipment, have found that when they need to solve a tough drilling operation it's "Hole Hog" or nothing in getting faster production.

The HD68, pictured here, is built in various modifications for special drilling problems and for years of trouble-free operation where heavy duty work is the rule. Straight line or special out-of-line drilling can be done to advantage with heavy and rugged Moline hydraulic rail feed machines. Easily adjustable spindle center distance provides maximum adaptability to many different jobs.

A catalog bulletin is available showing the interesting variations of the Moline HD68 Driller for angle or vertical drilling. Specific recommendations to cover the application of this type machine to your own particular work will be furnished upon receipt of information describing your requirements.



Write to MOLINE TOOL CO. HOLE-HOG MOLINE, ILLINOIS

C-F POSITIONERS

Save 72 Lifts

The Nordberg Manufacturing Co., Milwaukee, have eliminated 72 lifts per unit by using a C-F Positioner on the production job illustrated. These complex weldments (scavenging air headers for large Diesel engines) have to be "procedure-welded" and formerly required 72 crane lifts which took an average of 20 minutes apiece.

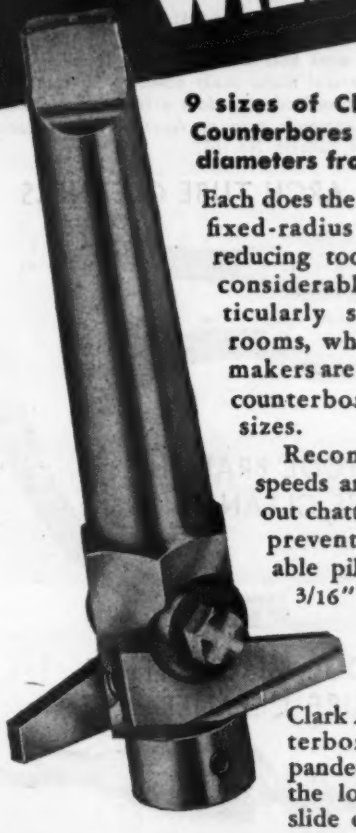
Now, the C-F Positioner moves the weldment through the routine positions under a push button control saving 24 hours crane time, 24 hours crane operator's time, and the same of both a sling man and the welder's time per weldment . . . in other words saving three man-days and one crane-day on each header produced.

C-F Positioners come in 6 sizes—capacities to 30,000 lb. All are pedestal mounted, rotate 360° and tilt to 135° beyond horizontal.

Write for Bulletin WP-22

CULLEN-FRIESTEDT CO. 1324 S. Kilbourn Ave., Chicago 23, U.S.A.

WHY USE 63 WHEN 9 WILL DO?



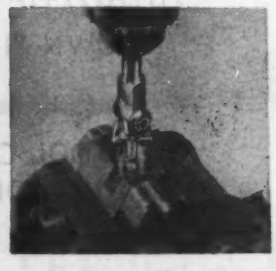
9 sizes of Clark Adjustable Counterbores cut all fractional diameters from ¼" to 5½".

Each does the work of 7 or more fixed-radius cutters, thereby reducing tool inventory costs considerably. They are particularly suitable for tool rooms, where tool and die makers are constantly needing counterbores of different sizes.

Recommended surface speeds are faster, and without chatter. Exclusive, burr-preventing interchangeable pilots available from 3/16" up, by sixteenths.

Clark Adjustable Counterbores are easily expanded. Simply loosen the locking bolts and slide cutting blades in or out. Blades are removable for sharpening.

No de-burring of pilot holes necessary.



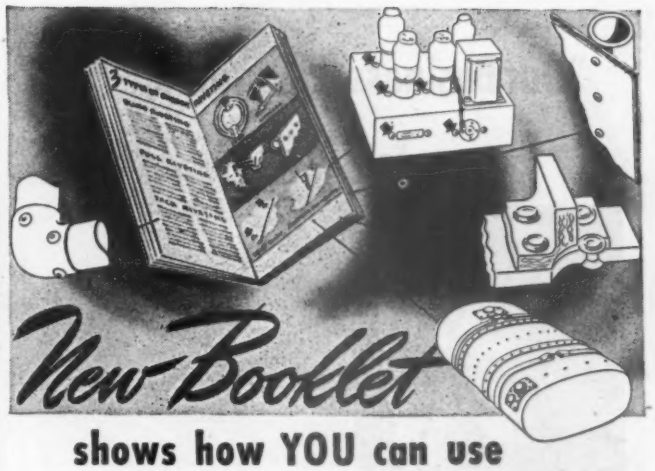
Clark Counterbores spot face as well as bore.

For complete information, call your Clark Cutter Jobber today or write for Catalog RME-2-CB.

CLARK CC CUTTERS

Robert H. Clark Company

9330 SANTA MONICA BOULEVARD · BEVERLY HILLS, CALIFORNIA

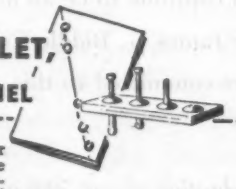


shows how YOU can use CHERRY BLIND RIVETS

This new three-color sixteen-page booklet—filled with application pictures and drawings—shows at a glance the outstanding features of Cherry Blind Rivets and suggests a large number of interesting new rivet uses, many of which may be applicable to your particular fastening and riveting problems. Send for it now!

Cherry Blind Rivets solve satisfactorily the time-worn problem of riveting in blind and hard-to-get-at spots. They are upset with a "pull" instead of a pound—from one side of the job by one man alone—their positive mechanical action assures satisfactory installations—they have proven their worth in many installations that are not necessarily blind—head up in metals, plastics, rubber, plywood, leather, fabrics, enameled surfaces.

Send for BOOKLET, DEMONSTRATION PANEL



I would like to glance through your new booklet D45. Please also send me the metal demonstration panel showing the stages in heading an actual Cherry Rivet.

Cherry Rivet Company, Los Angeles 13, California — Dept. A-277

Name_____

Address_____

City_____ Zone____ State_____

Firm_____ Title_____

CHERRY RIVETS, THEIR MANUFACTURE & APPLICATION ARE COVERED BY U. S. PATENTS ISSUED & PENDING

Cherry Rivet Company

LOS ANGELES, CALIFORNIA

"Our Business, Like Yours, ...is *Different!*"

A few comments based on the first 50 years of the JAMES G. BIDDLE COMPANY

• Businesses, like people, usually have distinct, individual personalities. The smaller the business, the more clearly it will reflect the character of the man who built it.

In 1895, when the electrical industry was in its infancy, James G. Biddle went into business as a manufacturer's agent, selling electrical measuring instruments and scientific apparatus. One of his basic aims in the conduct of the business was to be more than a mere source of supply. He decided to provide a service that was outstanding by reason of its alert, interested, personal character. This aim has never been changed by Mr. Biddle or his associates during the last half century. It will continue to be an important factor in the policies of the James G. Biddle Company in the years to come. We are committed to this.

•

In celebration of our 50th anniversary, we have prepared a brief booklet entitled "Report at Mid-Century." It touches upon interesting points regarding the growth and advancements of the electrical field in general and our business in particular. We would be pleased to send you a copy upon request.

JAMES G. BIDDLE CO. • 1211-13 ARCH ST. PHILA. 7, PA.

"MEGGER"* INSULATION TESTERS, GROUND TESTERS AND OHMMETERS • "FRAHM" TACHOMETERS AND FREQUENCY METERS • "JAGABI" RHEOSTATS • INDICATING HAND TACHOMETERS • SCIENTIFIC APPARATUS

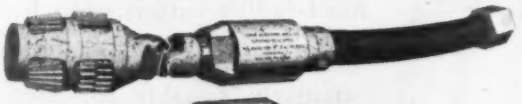
*TRADE MARK REG. U. S. PAT. OFF.

AIRETOOL TUBE CLEANERS

For Every Type of Locomotive Cleaning Job

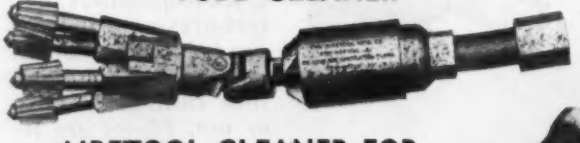
The removal of scale and foreign deposits from locomotive tubes can best be done with Airetool Tube Cleaners. Airetool Cleaners will not damage tubes; work best when the going is tough, because Airetool's unique power-seal motor loads down to 50 rpm without stalling—starts under heavy loads and does a faster, more thorough cleaning job. Get the complete story on Airetool Tube Cleaners—write today for Railroad Bulletin No. 17.

AIRETOOL ARCH TUBE CLEANERS

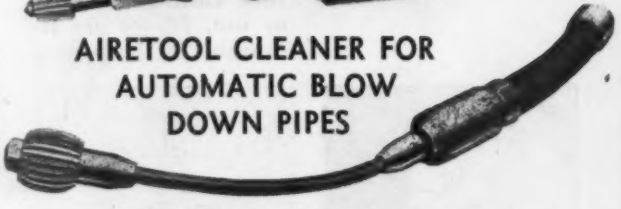


AIRETOOL BRANCH LINE CLEANER

AIRETOOL CIRCULATING TUBE CLEANER



AIRETOOL CLEANER FOR AUTOMATIC BLOW DOWN PIPES



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AIRETOOL TUBE EXPANDERS

Airetool also makes a complete line of Tube Expanders. They are precision-built of tested alloy steels. Write for new explanatory booklet.

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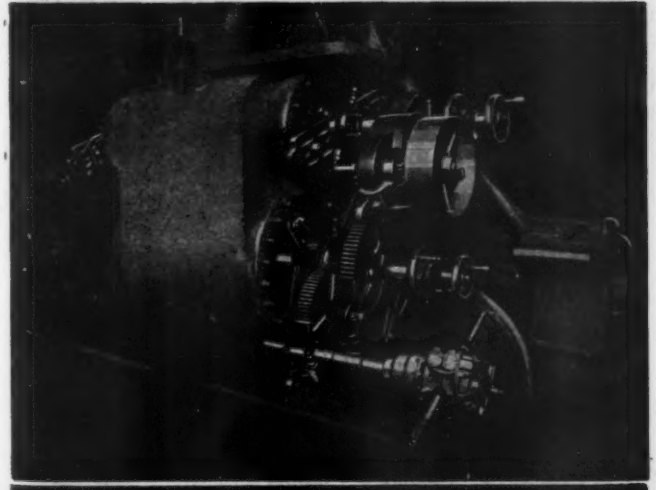

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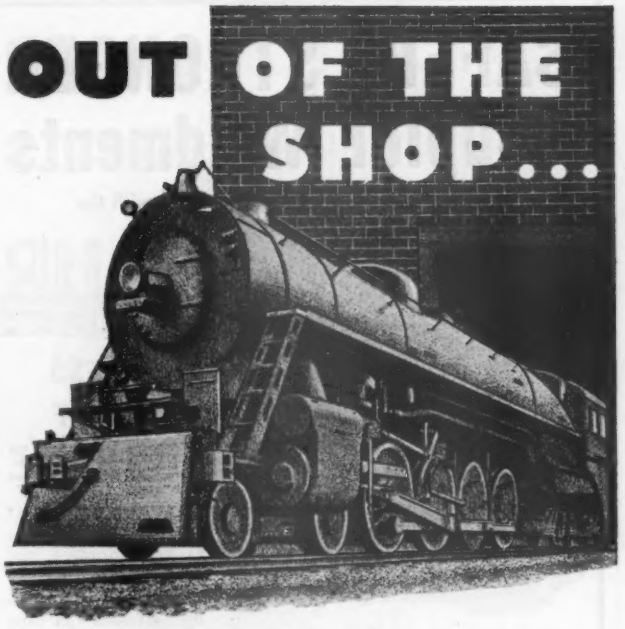

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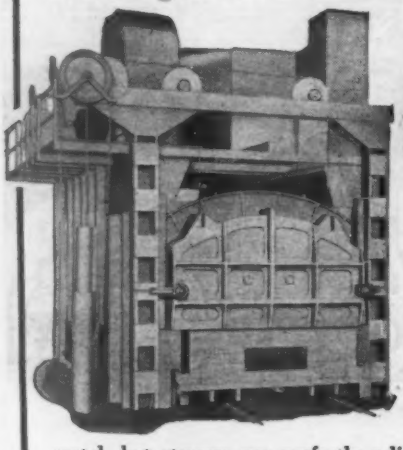

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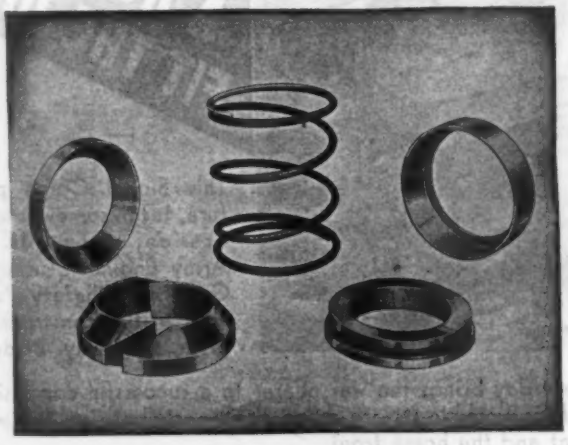

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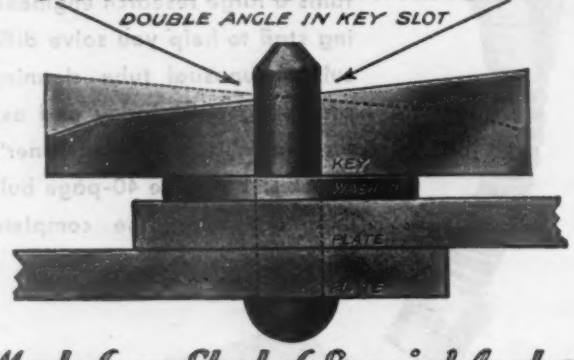

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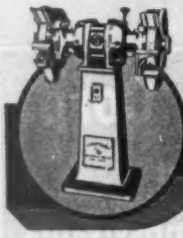

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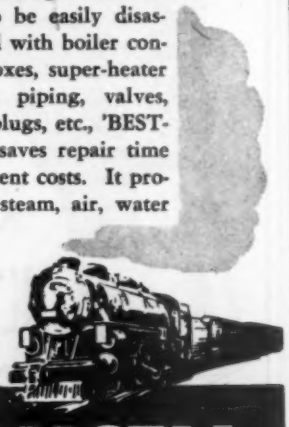

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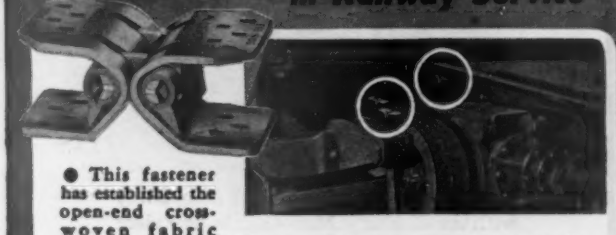
V-BELT FASTENERS

in Railway Service



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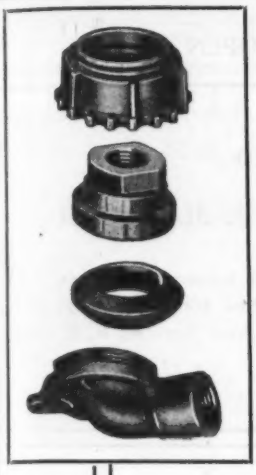

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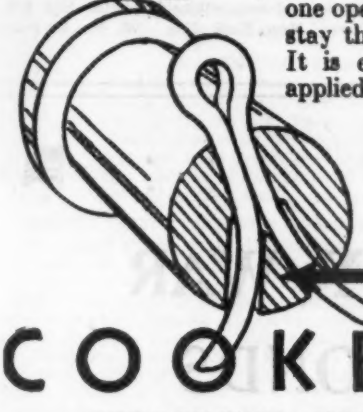

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1—Dump, Koppel Automatic, Drop-Door, 20-Yd., 40-Ton
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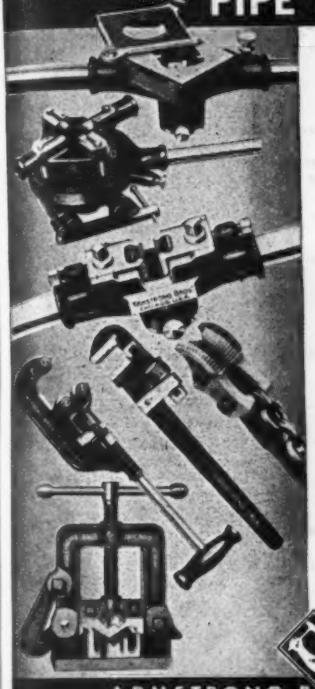

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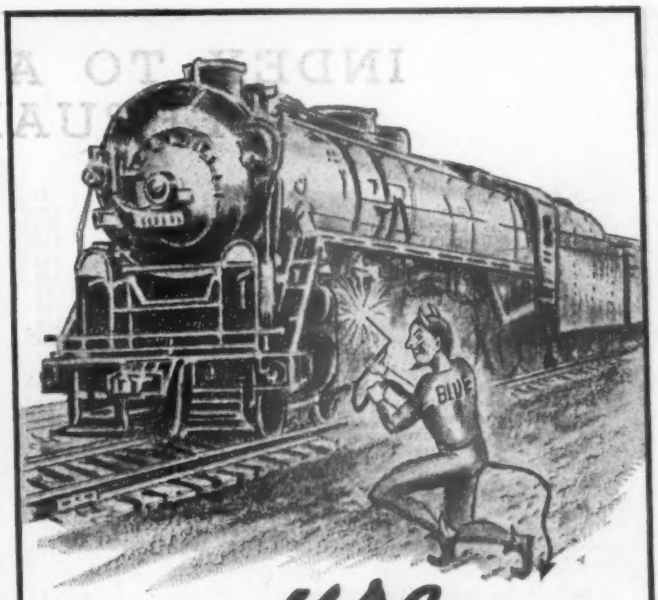

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Safety Gasoline Can

Ask your supplier about Justrite Safety Products or...write for prices and complete specifications

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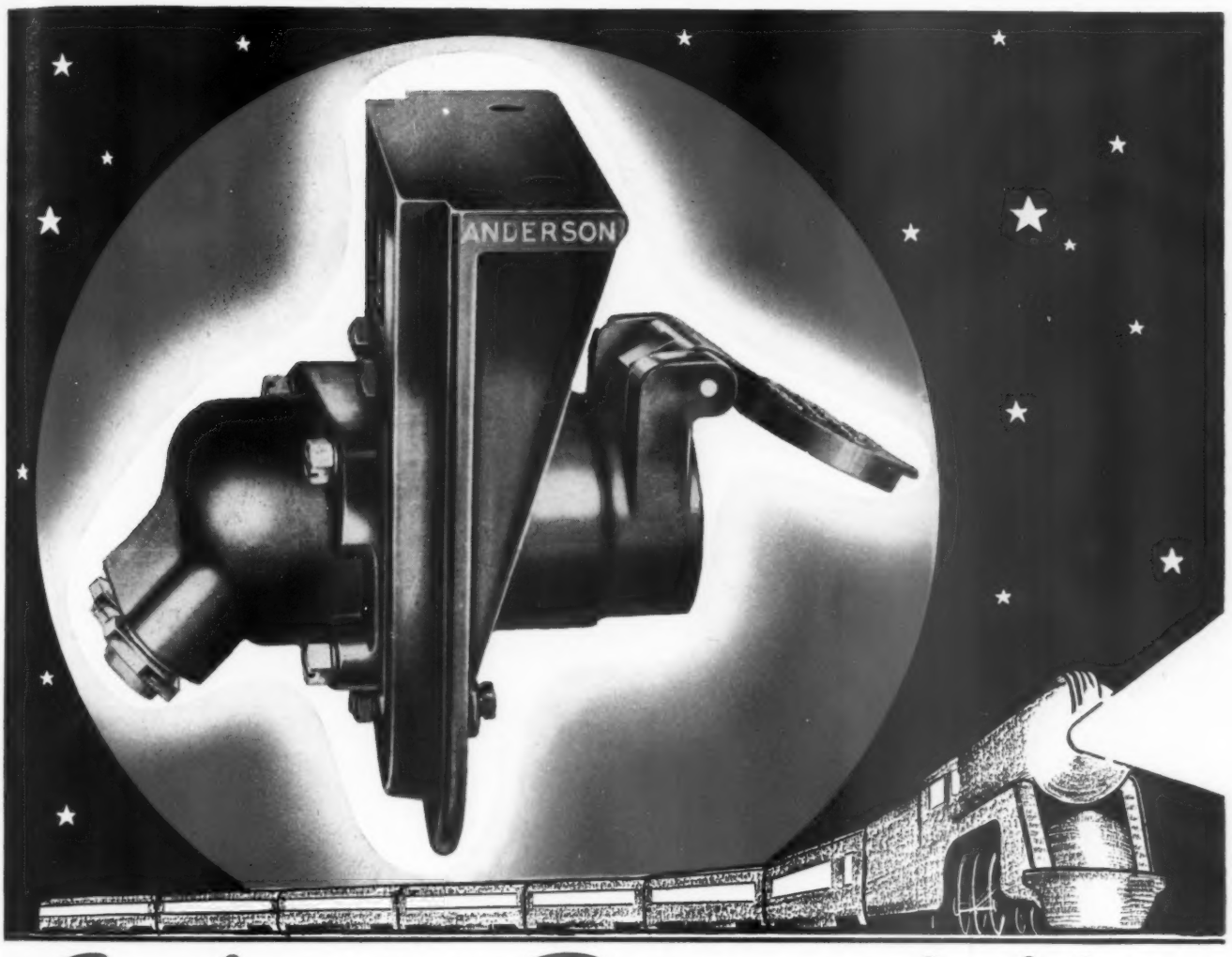

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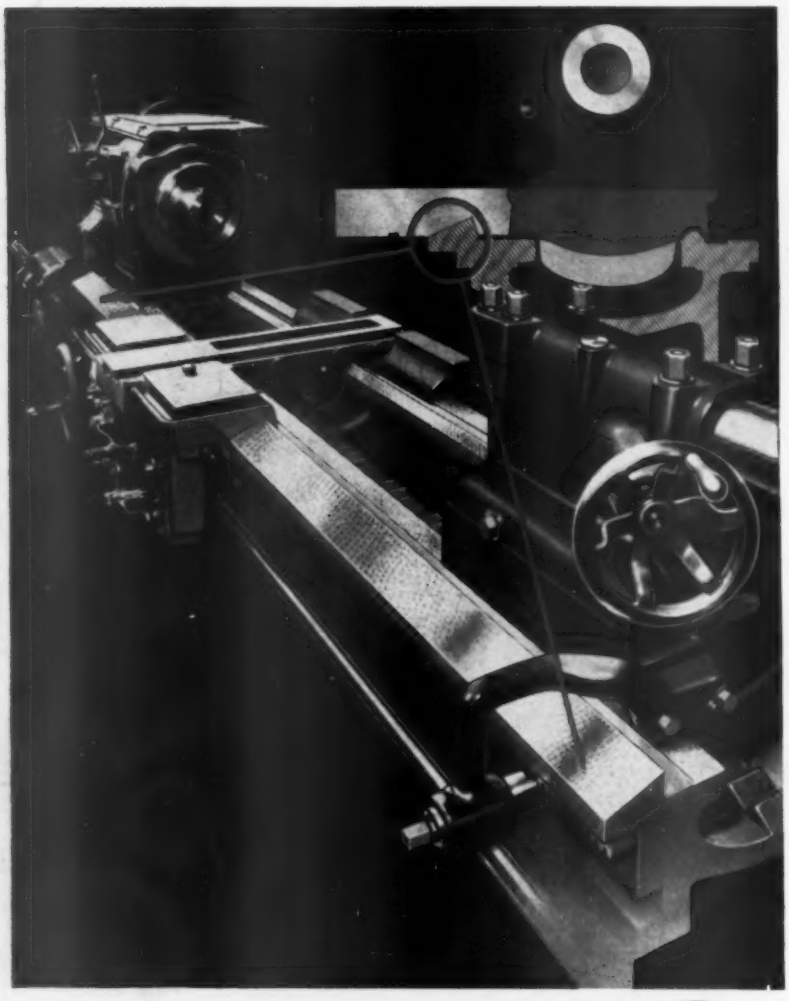

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